African-American Girls and Scientific Argumentation: Lived Experiences, Intersecting Identities and Their Roles in Constructing and Evaluating Claims

Phyllis Haugabook Pennock
Western Michigan University, phyllishpennock@gmail.com

Follow this and additional works at: http://scholarworks.wmich.edu/dissertations

Part of the Gender and Sexuality Commons, Race and Ethnicity Commons, and the Science and Mathematics Education Commons

Recommended Citation
http://scholarworks.wmich.edu/dissertations/595

This Dissertation-Open Access is brought to you for free and open access by the Graduate College at ScholarWorks at WMU. It has been accepted for inclusion in Dissertations by an authorized administrator of ScholarWorks at WMU. For more information, please contact maira.bundza@wmich.edu.
AFRICAN-AMERICAN GIRLS AND SCIENTIFIC ARGUMENTATION: LIVED EXPERIENCES, INTERSECTING IDENTITIES AND THEIR ROLES IN CONSTRUCTING AND EVALUATING CLAIMS

by

Phyllis Haugabook Pennock

A dissertation submitted to the Graduate College
in partial fulfillment of the requirements
for the degree of Doctorate of Philosophy
Science Education
Western Michigan University
June 2015

Doctoral Committee:

William Cobern, Ph.D., Chair
Susan Stapleton, Ph.D.
Megan Grunert, Ph.D.
Scientific argumentation can be traced back to ancient times; yet has seen a recent upswing over the last decade in the area of science education. This is due to current national education standards that ascribe this practice as a way of promoting scientific literacy for all. Current literature reflects an evolution of scientific argumentation – accommodating emerging research that uses socio-scientific issues. National standards highlight the need to teach argumentation, yet also recognize the urgent demand for educational equity of all students.

The purpose of this research was to narrow the gap dividing argumentation studies from other science discourse research. It explored nine African-American female students in two regular and one advanced placement environmental science classrooms at a suburban high school (grades 11 to 12) located in Midwestern United States. The study relied on sociolinguistics as an approach to understanding the various characteristics of discipline-focused classroom discussion for these students, guided by a well-known argumentation model which included tenets from Black feminist epistemology and intersectionality theory.
Participants used strategies that resulted in incomplete to complete arguments, with overall limited reasoning in the construction of their arguments. Cognitive reasoning was prevalent, suggesting a possible disconnect between the environmental topics and their engagement to the curriculum despite the appropriate use of this argumentative element. Evidence of the caring trait permeated the construction of certain arguments. Participants used their lived experiences and reconciled their social identities with their classroom science identity in various ways and which stemmed from their social locations.

Exploring the lived experiences uncovered psycho-socio-cultural and pedagogical factors in the social context of the activities. Themes relating to the nature of science and the personal and general relevancy of the environmental science topics arose as important components of their classroom science identity.

This study offers a novel approach to understanding how Black girls may construct scientific knowledge while constructing and evaluating arguments related to socio-scientific issues through their own lived experiences. Overall, culturally relevant approaches to teaching and researching marginalized students are crucial in order to ensure an inclusive science education in K-12 schools.
ACKNOWLEDGMENTS

I would like to thank my committee, Dr. William Cobern, Dr. Susan Stapleton, Dr. Megan Grunert for their constructive feedback, encouragement and support. Our regular meetings allowed me to remain focused and on schedule through the last leg of this journey. I would like to thank Dr. Renee’ Schwartz for her support and thoughtful insight over the years. I would like to thank Western Michigan University, along with Dr. Susan Stapleton and Tony Dennis for the financial support afforded to me by AGEP. Having this source of funding provided the peace of mind needed to pursue my academic goals.

I would like to thank my friends, mentors, and administrative support from the Sandra K. Abell institute and the Mallinson Institute of Science Education. I would also like to thank my care group, the Posts and the Baezes. Lastly, I would like to thank my beautiful family. To my husband Eric, who is my cheerleader through the good and trying times, my children, Simone and Erys – just looking at you provided the inspiration I needed to keep going. To my brother and sister, Peter and Patrice, for their ears and hearts. To my parents, Janice O’neal and Phillip Haugabook Sr. – you instilled in me a strong work ethic, a passion for social justice, and a sound spiritual foundation. Thank you for believing in me.

Phyllis Haugabook Pennock
TABLE OF CONTENTS

ACKNOWLEDGMENTS.............................................................................. ii

LIST OF TABLES ......................................................................................... ix

LIST OF FIGURES......................................................................................... x

CHAPTER........................................................................................................ 1

1. THE PROBLEM ........................................................................................... 1

1.1 Introduction............................................................................................ 1

1.2 Problem Statement.................................................................................. 2

1.3 Research Questions................................................................................ 5

1.4 Theoretical Framework........................................................................... 5

1.4.1 Socio-cultural theory.......................................................................... 5

1.4.2 Science discourse............................................................................... 7

1.4.3 Identity formation............................................................................... 9

1.4.4 Feminist philosophers of science and social location................. 10

1.4.5 Personal evidence and lived experiences................................. 11

1.4.6 African-American girls’ reasoning in argumentation............. 12
<table>
<thead>
<tr>
<th>CHAPTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.4.7 Intersectionality theory</td>
</tr>
<tr>
<td>1.4.8 Power relationships</td>
</tr>
<tr>
<td>1.5 Significance</td>
</tr>
<tr>
<td>1.6 Definition of Terms</td>
</tr>
<tr>
<td>1.7 Chapter Summary</td>
</tr>
<tr>
<td>1.8 Organization of the Study</td>
</tr>
<tr>
<td>2. LITERATURE REVIEW</td>
</tr>
<tr>
<td>2.1 Introduction</td>
</tr>
<tr>
<td>2.2 Critical Review of the Literature</td>
</tr>
<tr>
<td>2.2.1 Science discourse, identity, and non-dominant groups</td>
</tr>
<tr>
<td>2.2.2 Scientific/socio-scientific argumentation</td>
</tr>
<tr>
<td>2.3 Summary of Literature and Lessons Learned</td>
</tr>
<tr>
<td>3. METHODOLOGY</td>
</tr>
<tr>
<td>3.1 Research Design</td>
</tr>
<tr>
<td>3.1.1 Research questions</td>
</tr>
<tr>
<td>CHAPTER</td>
</tr>
<tr>
<td>------------------</td>
</tr>
<tr>
<td>3.1.2 Rationale for methodologies .................................109</td>
</tr>
<tr>
<td>3.2 Context ......................................................................116</td>
</tr>
<tr>
<td>3.3 Participants and Sampling ........................................119</td>
</tr>
<tr>
<td>3.4 Instruction and Curriculum ......................................121</td>
</tr>
<tr>
<td>3.5 Instrumentation, Data Sources, Data Collection ..............126</td>
</tr>
<tr>
<td>3.5.1 Data sources ........................................................126</td>
</tr>
<tr>
<td>3.5.2 My role as participant-observer ...............................136</td>
</tr>
<tr>
<td>3.6 Data Analysis ..........................................................139</td>
</tr>
<tr>
<td>3.6.1 Challenges and choice of software ............................139</td>
</tr>
<tr>
<td>3.6.2 Discourse analysis ................................................141</td>
</tr>
<tr>
<td>3.6.3 Student written work .............................................150</td>
</tr>
<tr>
<td>3.6.4 Classroom observations ........................................151</td>
</tr>
<tr>
<td>3.6.5 Interviews ...........................................................154</td>
</tr>
<tr>
<td>3.6.6 The researcher and minimizing bias ...........................154</td>
</tr>
</tbody>
</table>
CHAPTER

4. RESULTS AND ANALYSES ..........................................................158

4.1 Introduction .............................................................................158

4.2 Argumentation Elements in Classroom Practices ...............159

4.2.1 Variation in classroom activities and arguments ..........159

4.2.2 RES classes ........................................................................161

4.2.3 APES students ....................................................................193

4.2.4 Section summary .................................................................226

4.3 Lived Experiences .................................................................227

4.3.1 Bailey – love for environment, race, job, and economics.228

4.3.2 Brandy – economy and the concerned resident .............231

4.3.3 Amber – the place of education ........................................233

4.3.4 Section summary .................................................................235

4.4 Cultural and Psycho-Social “Gate-keepers” .........................235

4.4.1 Psycho-socio-cultural factors .........................................236

4.4.2 Pedagogical factors ............................................................250
Table of Contents - Continued

CHAPTER

4.4.3 Section summary .................................................................250

4.5 Identity Formation .................................................................251

4.5.1 Classroom identity assignments .........................................251

4.5.2 Classroom science identity ...............................................255

4.5.3 Race in the classroom .......................................................262

4.5.4 Other themes .................................................................277

4.5.5 Section Summary ............................................................282

4.6 Implementation of Scientific Argumentation .........................287

4.6.1 Phase and thematic shifts ..................................................287

4.6.2 Engagement of topic .........................................................292

4.6.3 Section Summary ............................................................293

4.7 Summary .............................................................................294

5. CONCLUSIONS AND INTERPRETATIONS ..............................296

5.1 Argumentation, Lived Experiences, and Implications ...........297
CHAPTER

5.2 Fitting Social Identities into Scientific Argumentation ..........300

5.2.1 Reconciliation of science identity with social identities ...307

5.3 Gatekeepers, and Multiplicity of Identities .........................317

5.4 Explicit and Open-ended Argumentation in the Classroom....319

5.5 General Implications to Ensure a Science for All ..............320

5.6 Limitations in the Study ..................................................322

5.7 Future Work .................................................................323

REFERENCES ............................................................................324

APPENDICES .............................................................................341

A. Human Subjects Institutional Review Board Approval Form .341

B. Interview Protocols ............................................................343

C. Discourse Analysis Templates and Maps ...............................462

D. Discourses strategies, Conventions, Codes, and Themes .......465

E. Presentation Boards .............................................................484
LIST OF TABLES

1 Demographics of female participants ................................................................. 119
2 General activity differences between RES and APES classes ....................... 125
3 Daily activities for RES classes ........................................................................ 127
4 Daily activities for APES class .......................................................................... 129
5 Steps in overall data analysis ............................................................................. 140
6 NGSS argumentation goals for 9-12 students .................................................. 146
7 Domains and associated factors (initial) ............................................................. 149
8 Initial codes for domain factors ......................................................................... 149
9 Argumentative elements of RES students ......................................................... 161
10 Discourse analysis of April during rebuttal ....................................................... 168
11 Discourse analysis of Bailey’s rebuttal during town hall .................................. 175
12 Discourse analysis of Bailey’s group ................................................................. 181
13 Argumentative elements for written and classroom in APES ......................... 195
14 Discourse analysis of Amber and Kylie for field trip ....................................... 211
15 Amy and Jerome’s field trip conversation ........................................................ 222
16 Psycho/socio-cultural and pedagogical factors for participants ..................... 238
17 Pedagogical factors ......................................................................................... 250
18 Identity assignments ......................................................................................... 252
19 Discourse analysis of Kylie and Darnell – “othermothering” ......................... 284
20 Discourse analysis of Brandy and Maya – “othermothering” ......................... 285
LIST OF FIGURES

1 Calabrese Barton’s pedagogy in the classroom .......................................................... 36
2 Example of Toulmin's argument pattern using marginalized groups .................. 50
3 Original set-up of Mr. J.’s classroom ........................................................................ 122
4 Revised set-up of Mr. J.’s classroom ........................................................................ 122
5 Seating arrangement of first hour RES students ...................................................... 123
6 Seating arrangement of second hour RES students ................................................. 123
7 Seating arrangement of APES students ................................................................. 124
8 Original CER-R model ............................................................................................ 147
9 Modified CER-R model ........................................................................................... 147
10 The Bailey group presentation board ................................................................. 167
11 Kylie’s position statement on bighorn sheep ........................................................... 204
12 Amy’s position statement on bighorn sheep ........................................................... 205
13 Mr. J. demonstrating kick-net during field trip ....................................................... 206
14 CER-R handout for Mr. J.’s field trip ...................................................................... 207
15 Introduction slide of Kylie and Amber's group ....................................................... 217
16 Kylie and Amber's group defining turbidity ......................................................... 217
17 Conclusion of Kylie and Amber's experiment ......................................................... 218
18 Purpose of Amy and Jerome's field trip experiment ................................................ 225
19 Data collected during Amy and Jerome's experiment ............................................. 225
List of Figures - Continued

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>Lived experience map for Bailey</td>
<td>231</td>
</tr>
<tr>
<td>21</td>
<td>Lived experience map for Brandy</td>
<td>234</td>
</tr>
<tr>
<td>22</td>
<td>Identity map for Bailey</td>
<td>265</td>
</tr>
<tr>
<td>23</td>
<td>General revised argumentation model</td>
<td>297</td>
</tr>
<tr>
<td>24</td>
<td>Social location, lived experiences and arguments</td>
<td>299</td>
</tr>
<tr>
<td>25</td>
<td>Model depicting role of identities</td>
<td>301</td>
</tr>
<tr>
<td>26</td>
<td>Classroom science identity and other social identities</td>
<td>303</td>
</tr>
</tbody>
</table>
CHAPTER 1

THE PROBLEM

1.1 Introduction

Scientific argumentation can be traced back to the times of Aristotle and Plato; yet has seen a recent upswing over the last decade in the area of science education (McNeill & Pimentel, 2010; Sadler & Zeidler, 2005). This is due to current national education standards that ascribe this practice as a way of promoting scientific literacy for all (National Research Council [NRC], 2011). Current literature reflects an evolution of scientific argumentation – accommodating emerging research that uses socio-scientific issues (SSIs) to teach argumentation practices (McNeill & Pimentel, 2010; Sadler & Zeidler, 2005).

Science discourse studies explore the role of students’ identities (e.g., gender and race) in understanding scientific knowledge production for underrepresented groups (Brown, 2004; Calabrese Barton, 1998). However, the current body of research on scientific argumentation lacks a similar lens when studying how this practice is implemented in the classroom. This is especially true for marginalized students such as African-American girls (Berland & Reiser, 2011; McNeill & Pimentel, 2010). National education standards discuss the importance of learning scientific argumentation in the classroom, yet also recognize the need for educational equity of all students (Next Generation Science Standards [NGSS], 2013; NRC, 2011). Current argumentation models, such as the Claim-Evidence-Reasoning-Rebuttal (CER-R) framework have been instrumental in bringing scientific argumentation to marginalized student populations.
(McNeill & Krajcik, 2012). This model simplifies instruction of an argument’s components; allowing for easier adaptation in the science classroom and proper assessment of student learning (McNeill & Pimentel, 2010). However, due to its focus on argument structure, it does not account for understanding the ways African-American girls' identities may impact their learning of scientific arguments (McNeill, 2011; McNeill & Krajcik; McNeill & Pimentel, 2010). Future studies are needed that seek to address the ways historically marginalized groups such as African-American girls construct and evaluate scientific arguments to best ensure all students achieve scientific literacy.

1.2 Problem Statement

In A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideals (2011), the National Research Council preface their conceptual framework for national science standards by stating,

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, 2011, p.1)

Indeed science pervades many areas of our lives. However, statistics show that many do not have the basic scientific knowledge and experience to comprehend the rapidly changing technology needed in issues such as medicine, alternative energy, and the environment (Lee & Roth, 2002; NRC, 2011). In response to this, the NRC framework and its transformative project, the NGSS assert the need to prepare students
to learn science and engineering, with the goal of preparing students to graduate as scientifically literate citizens (NGSS, 2013; NRC, 2011). The practices and concepts presented by the NGSS in response to the NRC framework serve to address the disparities found in schools across the country, where engaging students into the wonderful world of science is amiss, and one in which educators emphasize a broad scientific knowledge irrelevant of the necessary in-depth scientific practices that scientists must encounter (NRC, 2011, p. 1). This literature also ascribes science as a highly social practice in uncovering explanations of the natural world, whereby scientists can conjure hypotheses both as individuals and collectively in groups (NGSS, 2013; NRC, 2011). The community of scientists must eventually work together in the creation and revision of theories; with such science discourse reflecting the culture of its society. It follows, then, that such gatherings are reliant on the norms of its ever-changing environment (2011).

One specific form of scientific discourse, scientific argumentation, is vital in promoting scientific literacy in K-12 schools (Berland, 2011; Berland & Reiser, 2011; McNeill, 2011; McNeill & Pimentel; NRC, 2011; Simon, Erduran, & Osborne, 2006). Emerging research also reflects the usefulness of viewing argumentation as a form of informal reasoning involving socio-scientific issues (SSIs) (McNeill, 2011; McNeill & Pimentel; 2010; Rose & Calabrese Barton; Sadler, 2004; Sadler & Zeidler, 2005). Using SSIs allows students to form their own personal connections to such topics, engaging them in the practice of argumentation (McNeill, 2011; Sadler, 2004; Sadler & Zeidler, 2005).
The benefits of argumentation are significant; yet teaching this science discourse may be an impediment to certain non-dominant groups (Atwater, 1996; Brown, 2004). To address this, the NRC contends that educational equity is its goal, ensuring that all students, including underrepresented ones, receive similar opportunities to learn and are involved in both science and engineering-related courses in school (NRC, 2011). Still, problematizing the goal of science literacy is necessary due to continual downward trends in scientific learning and achievement (NGSS, 2013). Further, Calabrese Barton remarks that this seemingly inclusive mantra of “science for all” often leaves certain students “in the margins” (1998, p. 379). This is due, in part, to the cultural conflict that occurs between students and teachers in the classroom (Atwater, 1996; Brown, 2004; Brown, Reveles, & Kelly, 2005; NRC, 2011).

This research sought to specifically focus on African-American girls due to the scarcity of argumentation literature exploring this population (Brown, 2004; Calabrese Barton, 1998; NRC, 2011). Studies implicate that engaging non-dominant groups, particularly African-American girls, in scientific practices such as argumentation requires an alternative vantage point that stresses the realities of learning science in schools today (Calabrese Barton, 1998; Hill Collins, 2009; Zambrana & Dill, 2009). One reason for cultural conflict in the classroom as it relates to African-American girls is that pedagogical practices neglect the complex social locations or identities of these students, placing them in disadvantageous positions to learn science compared to their peers (Calabrese Barton, 1998; Harding, 1998; Potter, 2006). Hence, the purpose of this research was to add to existing argumentation literature by exploring how African-American girls use their social locations (i.e. the hierarchal positions of their race, class,
gender, etc.) or intersecting identities in their construction and evaluation of arguments. The goal is to prompt science educators to discover novel pedagogical practices in teaching argumentation; mindful of these findings.

1.3 Research Questions

The initial research questions that informed this study focused on the construction of arguments and the classroom environment.

1a. What are the characteristics of discipline-focused discussion for African-American girls in a high school science classroom?

To narrow this to the focus of argumentation-based activities, a deeper question is necessary.

1b. How would analysis of these discussions and student written work look when guided by an argumentation model and feminist theoretical framework which values the roles of lived experiences of an individual?

In order to evaluate this in the classroom context, a research question was necessary to explore this factor in relation to the study participants.

2. How does the nature of the classroom climate relate to how African-American girls practice argumentation?

1.4 Theoretical Framework

1.4.1 Socio-cultural theory

The theoretical framework for this research is informed by several theories and empirical studies. Social constructivist theories form the basis of this study in which
social and cultural processes are considered essential to understanding how a child learns. (Driver, Asoko, Leach, Mortimer, & Scott, 1994; Nasir & Hand, 2006). Research that explores the acquisition of scientific knowledge through a social context considers classrooms as communities (Driver et al., 1994; Erduran and Jimenez-Aleixendre, 2007). Proponents of this framework emphasize that engaging students in social activities that involve mutual scientific tasks in the classroom allows them to construct knowledge (Driver et al. 1994; Nasir & Hand, 2006). Hence, effective learning that includes social interaction and language are highly significant for students when learning science (Driver et al., 1994, p. 7).

Nasir and Hand (2006) provide several elements of sociocultural theory. First, student learning develops temporally from the microlevel (i.e. in student interactions) to the macrolevel (over many years). Second, grasping the cultural practices of a community (i.e. the science classroom) is imperative to understanding how a student develops in the classroom (Nasir & Hand, 2006). Third, sociocultural theories have culturally-defined tools – language, symbols, and artifacts that help guide learning and development (Nasir & Hand, 2006). The meaning of artifacts vary across disciplines; though some science education scholars attribute this term to argumentation practices, models and explanations (Sampson & Clark, 2008; Sandoval and Millwood, 2005). Lastly, teachers and students, through their complex interactions, enact important roles in student learning and development (Nasir & Hand, 2006). From this perspective, science educators and researchers view the classroom as a constructive environment with science as its dominating culture. It thus follows that through the culture of science, children should be familiar with the discourse of science. Consequently, the overall goal in
sociocultural theory is to acclimate and appropriate students into the culture of science by means of “concepts, symbols, and conventions of the scientific community.” (Driver, Squire, Rushworth, & Wood-Robinson, 1994, p. 8).

1.4.2 Science discourse

Acclimation into science doctrine involves mastering the use of discursive practices in the acquisition of scientific knowledge (Jimenez-Aleixandre & Erduran, 2007). Lemke’s influential contention concerning the language of science as best taught through students talking science should not be minimized (Jimenez-Aleixandre & Erduran, 2007). Teaching science discourse effectively, however, involves much more than surmising different types of dialogue, particularly as it relates to historically underrepresented groups (Atwater, 1996; Brown, 2004; Calabrese Barton, 1998; Gee, 1999). Atwater states that traditional frameworks in science education placed scant emphasis on the cultural background of learners (1996). In reality, students adopt different types of discourse depending on what type of real-world communities they are members of – practices that will not vanish once students attend school (Brown, 2004; Driver, 1994; Moje, Ciechanowski, Kramer, Ellis, Carrillo, & Collazo, 2004). Likewise, Gee further reminds us,

…language never operates all by itself. It is always a tool fully integrated with the social and cultural contexts within which it is used, contexts it always simultaneously both reflects and helps to create. Just looking at the features of language and not social, cultural, and institutional factors integrated with language and meaning is not good socio-linguistics (Gee, 2009, p. 4)

As Gee affirms, understanding the ways and reasoning behind language usage in sociolinguistics involves a critical focus on its surrounding environments, referred to as “embodied language” (Bucholz and Hall, 2008, p. 411). Accordingly, in the context of
the science classroom, understanding the cultural background of the student and how he or she uses language is fundamental when facilitating the practice of science discourse in the classroom (Brown, 2004; Gee, 1999). Gee exemplifies this in an essay describing his observations of the developing tensions between an African-American girl and her White teacher. In this instance, the teacher asks the girl a question that requires a seemingly straightforward answer (Gee, 2009). However, the student appears to “ramble[e] on” instead of providing the response the teacher seeks, frustrating both individuals (Gee, 2009, p.2). Years later, Gee remarks that the girl, though highly gifted and verbose, still had not mastered scientific talk.

Atwater further illustrates how cultural tensions between both the learner and the teacher have significant impacts in learning (1996). In a study described by Atwater (1996), cultural conflict occurred between Latino students and White teachers due to their different language styles. While teachers were intent on preparing students in ESL classes on how to better equip themselves in a dominant culture, the students were more interested in their outward appearances, including theirs clothes and jewelry, a significant form of non-verbal communication (Atwater, 1996). Hence, teaching scientific topics to a generic student population, with little to no regard of a student’s cultural background is seen by many as ineffective (Atwater, 1996; Brown, 2004, 2006; Brown et al., 2005). Based on this premise, Brown and colleagues performed several influential studies on cultural conflict among youth in an urban high school classroom (Brown, 2004; Brown et al., 2005). Brown coined the term discursive identity to differentiate the various ways students resolved to master scientific discourse in lieu of their home communities (2004, 2006; Brown et al., 2005).
1.4.3 Identity formation

This research is also grounded in literature that describes identity formation as it relates to science education (Calabrese Barton, 1998, 2001; Brown, 2004; Brickhouse & Potter, 2001; Carlone and Johnson, 2007). Broadly speaking, previous education studies assert that a more holistic perspective that includes a critical and feminist lens is beneficial for African-American girls (Atwater, 1996; Calabrese Barton, 1998; Carlone, 2004). Calabrese Barton describes the necessity of such a lens in lieu of power relationships that influence current pedagogical practices (1998). One prominent way in which these relationships are viewed in literature is through the lens of student identity formation. Many different definitions of identity are found in science education literature (Brickhouse & Potter, 2001; Brown, 2004; Calabrese Barton, 1998). Brickhouse and Potter describe this process as “[the] ways in which one participates in the world and the ways in which others interpret participation” (2001, p. 966).

Gee describes an interrelated connection between how an African-American girl may represent herself (i.e., her identity) and discourse related to a specific area, such as science discourse (2009). Gee and other authors make the distinction between this type and general discourse by capitalizing the former with a “D” (Gee, 2009; Sadler & Fowler, 2009). Hence, argumentation as a discourse is one way that African-American girls may enact their science identity.

As found in other science discourse studies, African-American girls are not separate from other social identities (e.g., race and gender) when constructing their science identity in the classroom (Brickhouse & Potter, 2001; Carlone & Johnson, 2007). Several findings reinforce the notion that understanding the social identities of African-
American girls is crucial in developing strong science identities (Brickhouse, Lowery & Schultz, 2001; Brotman & Moore, 2008; Calabrese Barton, 1998). Because of this, teachers and researchers must expand the normative culture of science to include their identities as a means to ensure scientific literacy (Calabrese Barton, 1998).

1.4.4 Feminist philosophers of science and social location

The theoretical perspectives of identity formation stemmed from the work of critical and feminist scholars (Atwater, 1996; Brickhouse & Potter, 2001; Calabrese Barton, 1998). The first wave of feminism began in the 1960s and led to the advent of feminist philosophers and epistemologists of science in the 1970s and 80s who challenged previous androcentric versions of knowers and knowledge (Code, 1980; Harding, 1998; Keller, 2004; Calabrese Barton, 1998). Calabrese Barton remarks that these various approaches led to different ways of “bringing women and minorities into science by focusing on achievement, attitudes, and participation in science” (1998, p. 3). This time period brought to light various ways women and minorities were ostracized from obtaining a science education.

One important perspective originating from feminist philosophers such as Haraway (1986) focuses the acquisition of scientific knowledge on an individual’s social location (Weber, 2009, p. 21). Weber defines social location as “refer[ring] to an individual’s or a group’s social ‘place’ in the race, class, gender, and sexuality hierarchies, as well as in other critical social hierarchies such as age, ethnicity, and nation” (2009, p. 24). Hence, the social location highlights the intersection of these social identities. Feminist scholars encouraged others to embrace the concept of partial knowledge situated by the knower’s social location or background, including the views
expressed by both oppressed and privileged groups (Brickhouse, 2001; Haraway, 1986; Lang, 2010). Consequently, this research holds the assumption that every student has his or her own social location, determined by the intersection of their race, class, gender (to name only a few) and all of the inequitable social structures that exist from this intersection (Weber, 2009). Hence, their construction of scientific knowledge is determined in part by the experiences and perspectives that stem from these social locations (Haraway, 1986; Lang, 2010).

### 1.4.5 Personal evidence and lived experiences

Research on underrepresented students in literature demonstrates students’ home cultures and lived experiences play a significant role in the classroom (Brown, 2004; Calabrese Barton, 1998, 2001). Though epistemologically separate from lived experiences, the inclusion of students' personal experiences as a way of supporting SSI claims in argumentation is also prominent in literature (McNeill & Pimentel, 2010; Rose & Calabrese Barton, 2012; Sadler & Zeidler, 2005). For instance, Rose and Calabrese Barton contend that personal experiences as well as “family, relationships…and societal discourses have all been shown to be important factors affecting students’ thinking about socio-scientific issues” (2012, p. 2). Sadler and Ziedler (2005) assert that student thinking involving SSIs is based on social and emotive considerations, as well as personal experiences. This conveys the complexities of individual resources that students rely on from their daily lives when navigating such topics.

In argumentation literature, the relevancy of personal experiences is explored among urban youth (McNeill, 2011; McNeill & Pimentel, 2010). McNeill and Pimentel report that the students in their study use evidence that is both scientific and personal
when evaluating SSIs (2010). The authors define personal evidence as that which emerges from “personal experiences” (McNeill & Pimentel, 2010, p. 211). However, lived experiences framed within Black feminist thought and intersectionality theory offers a distinct departure from the “personal experiences” described in the aforementioned argumentation literature (Hill Collins, 2000; McNeill, 2011; McNeill & Pimentel, 2011; Sadler & Zeidler, 2005). One reason is that relying on the proposed framework purposefully places African-American girls' experiences in an interlocking system of race, class, and gender (Hill Collins, 2000). In work describing her Black feminist epistemology, Hill Collins outlines several important assumptions to consider when exploring how these individuals may construct (scientific) knowledge, with an emphasis on the vital connection between the knower and their partially situated knowledges (Hill Collins, 2000). One such assumption is that through constructing and evaluating arguments, including the use of claims, evidence, and reasoning, individuals may rely on these lived experiences (Hill Collins, 2000). Hill Collins specifically directs readers to the importance of these types of experiences for African-American women when constructing meanings (2000). Moreover, she describes how African-American women will use “practical images as its symbolic vehicles…in African-American thought systems” (Hill Collins, 2000, p. 258). In the context of a science classroom, these practical images could involve personal narratives to help with sense-making of certain scientific phenomena (Hill Collins, 2000).

1.4.6 African-American girls’ reasoning in argumentation

In the argumentation model that will help guide the direction of this study, McNeill and Krajcik discuss the role of reasoning in constructing arguments (2008,
The reasoning in this model is an explanation of the use of evidence to support the claim (McNeill & Krajcik, 2008, 2012; McNeill & Pimentel, 2010). Previous work in socio-scientific argumentation shows that students may navigate SSIs using several modes of reasoning when justifying their claims. These modes cover both cognitive (rationalistic), emotive and intuitive domains (Sadler & Zeidler, 2004; 2005). Failure to address all domains could result in excluding a significant student population when it comes to certain SSIs (Sadler & Zeidler, 2005). Outside of the realm of science education, philosophical scholars also discuss the importance of these domains (Carofiglio & de Rosis, 2003; Gilbert, 1994, 2001; Hill Collins, 2000). Gilbert argues that all arguments contain these domains and that to include only a rationalistic mode would result in “prejudiced reductionism” (Gilbert, 1994, p. 159). In her Black feminist epistemology, Hill Collins posits that “neither emotion [nor] ethics is subordinated to reason. Instead, emotion (i.e. compassion and empathy), ethics, and reason are used as interconnected, essential components in assessing knowledge claims” (2000, p. 266). If lived experiences of African-American girls are indeed connected to personal evidence as the personal experiences of students in McNeill & Pimentel’s study, then it stands that reasoning which supports evidence also relies on these lived experiences as well (2010). These lived experiences stem from the identities or social location of these girls (Brickhouse, 2000; Brickhouse & Potter, 2001; Calabrese Barton, 1998; Carlone & Johnson, 2007; Moore, 2007). Consequently, this research holds the assumption that these experiences may uncover “oppressive and privilege practices” and the enactment of various identities for each student – ultimately providing a richer picture of the construction of scientific knowledge (Lucal, 1996, p. 245). In the context of
argumentation, this may provide a broader means in which to include the ways in which arguments are constructed (Haraway, 1986; Lucal, 1996; Weber, 2010).

Consequently, the above discussion demonstrates that reasoning for students in the construction of arguments relies on more than just a rational component. Because these emotions and intuitions indicate students’ personal ties to the issues, taking into account these modes as defined by scholars are necessary when evaluating the origin of student’s overall reasoning which supports the evidence of a particular claim (Hill Collins, 2000; Sadler & Ziedler, 2005). These personal ties also provide another opportunity to gain insight into the lived experiences and social identities of students in order to understand what role they may have in the construction and evaluation of arguments.

1.4.7 Intersectionality theory

Since the third wave of feminism began, one of the most ambitious projects in this area of feminist science studies is evaluating the intersectionality of how race, gender, class have become interwoven into science through the perspective of the knower (Weasel, 2004). Other Black feminists claim this concept has taken place since the 19th century by the Black feminist Mary Stewart (Dill & Zambrana, 2009; Gines, 2011). Gines also provides descriptive accounts of other prominent women who fought for both race and gender such as Sojourner Truth and Anna Julia Cooper (2011).

The overwhelming number of Black feminist scholars that have contributed prolific work in intersectionality theory previous to and throughout the third wave of feminism is startling (Bowleg, 2008; Choo & Ferree, 2010; Dance, 2009; Dill & Zambrana, 2009; Gines, 2011; Hancock, 2007; Hill Collins, 2009; McCall, 2005;
Zambrana & MacDonald, 2009; Weber, 1998). Still, there are a relatively few number found in science education (Johnson et al., 2011).

Hill Collins is credited for expanding the model of intersectionality (Dill & Zambrana, 2009). She provides an extensive definition of intersectionality from the work of Dill & Zambrana (2009) that encompasses the scholarly work for this venue in the past thirty years (2009). She states,

[It is an] innovative and emerging field of study…provides a critical analytic lens to interrogate racial, ethnic, class, ability, age, sexuality, and gender disparities and to contest existing ways of looking at these structures of inequality, transforming knowledges as well as the social institutions in which they have found themselves (Hill Collins, 2009, p. vi).

In Hill Collins’ analysis of the changing views of intersectionality, she pinpoints the time of the 1970s and 1980s as providing crucial scholarly work on intersectionality before Crenshaw’s analyses in the early 1990s (2009). However, she also argues that during the time Crenshaw exposed this area of scholarship by formally labeling it, research changed dramatically to reflect a look inward into people’s own lives. Although beneficial in its own right, these studies also shifted the burden of responsibility more on the individual experiencing the inequalities (Hill Collins, 2009). Consequently, institutions such as schools, governments, and workplaces were free to continue constructing and practicing policies that reinforced such disparities. Because of these macro-societal influences, Dill and Zambrana define inequality as “institutionalized patterns” of disparate control over valued commodities such as education, healthcare, employment, etc. (2009, p. 1). Hence, intersectionality seeks to transform these practices by studying the ambiguity of human experience swathed in a cloth of institutional inequality (Dill & Zambrana, 2009).

Though an ambitious and seemingly formidable project, strong proponents of this model
agree that such work is unequivocally necessary and informative. The need lies both in academia where scholarship focuses on the social identities of people and institutional sources of inequity as well as in the everyday lives of certain people who are simply attempting to earn a living and obtain equitable education and affordable quality healthcare, among others (Dill & Zambrana, 2009; Hill Collins, 2009).

Accordingly, for African-American girls in a high school, one can analyze work on both “individual” and “structural” levels (Dill & Zambrana, 2009, p. 4). On the individual level, one can evaluate how these students express or alter their identities while immersed in the institutional social practices of the science classroom. On a structural level, one may assess how classrooms and schools utilize their power to create or maintain their disparate traditions. Although this description seems to align with previous studies of identity focusing on race (Brown, 2004, 2005, 2006; Emdin, 2010), purposefully centering African-Americans experiences demonstrates that using race alone is highly limiting in providing a coherent picture of existing inequalities (Dill & Zambrana, 2009). For this research, I wished to focus more on the individual level of intersectionality theory, where I attempted to evaluate African-American girls’ use of argumentation as it relates to the science classroom. However, it was important for me to remain mindful that these individual actions were also manifested through the social structures these girls lived in on a daily basis. In actuality,

[T]he opportunity for a college preparatory K-12 education is influenced by one’s race but also by class position in the society and within that racial group, as well as by gender and perceptions and expectations of one’s gender based on class, race, region, ability, and so on (Dill & Zambrana, 2009, p. 5)

Hill Collins and hooks also remark that “class matters” when evaluating race and that there exists a “new racism” which encapsulates race, gender, class, and sexuality
(Henderson & Tickamyer, 2009, p. 57). Unfortunately, current argumentation literature often portray race as a conflation of other identities that warrant equal attention (Berland, 2011; Berland & Reiser, 2011; Emdin, 2010; McNeill, 2011; McNeill & Pimentel).

Weber (1998) seeks to reconcile some ambiguity in the literature by outlining the tenets of the intersectionality conceptual framework. First, identities are contextual, meaning these identities are distinct across historical and regional contexts. Weber offers a clear example with the term “Native American” – which was created when dominant groups sought an easy way to describe these people, regardless of the distinct tribal groups. Although widespread belief is that the term is deemed politically and socially acceptable, individuals of various tribes have taken offense to this term, rightfully pointing out that it implicitly erases the diverse tribal and cultural traditions associated with each Native American group. Because of this, tribes essentially prefer to be recognized according to their tribal affiliations.

Second, race, gender, and other identities are socially constructed. Dominant groups historically used biology as evidence for these dichotomies, which were subsequently rejected (Weber, 2010). Instead, Weber proclaims that these categories were created as a way to enforce power relations between the historically dominant and subordinate group.

Third, race, gender, and sexuality, etc. are identities embedded in power relationships (1998). That is, these identities are not just categorical ways of describing an individual, but also result in a power struggle between historically dominant and non-dominant groups over valuable resources. These resources are political, economical, and social.
Fourth, evaluating identities of individuals extensively involves analysis on both the macro and micro levels. The macro level consists of institutional, governmental, and societal influences such as statistical trends regarding “wealth, income, jobs, and housing, and in the health status of people” (Weber, 1998, p. 21). The micro level involves highlighting individual acts of resistance for those in non-dominant groups. For instance, in Calabrese Barton’s example of Mexican-American school girls, she mistakenly believed that the boys in their science class prevented these girls from speaking up in class (2001). However, she soon discovered that the girls were expressing their own act of resistance by refusing to raise their hands in this normative classroom. Other examples outside of education involve job and political protests, the formation of small unions on the job, and defending negative stereotypes on a daily basis (Weber, 1998). Hence, resistance may also be one way of demonstrating the agencies of individuals in relation to structural inequalities. Weber further points out that examples such as these suggest that “the key aspect of dominance, then, is not whether people have access to psychosocial resources but whether the social order supports or constrains people’s development” (1998, p. 23).

Fifth, race, gender, sexuality and other identities are mutually constructed and simultaneously expressed on both the macro and micro levels. This means that race, gender, and other identities are not expressed in everyday lives as separate from each other, but are viewed together; though one identity may prevail over another in various contexts (Weber, 2010). An example of these mutually constructed identities may be found in social media, where Black women are unjustly portrayed as sexually promiscuous in the genre of music and film. This is not apparent with Black men; hence
race and gender do play roles in a mutual manner. Because these identities are also contextual, the implication is that most individuals may act as oppressors or the oppressed in various environments. Hence, Black males may themselves be agents of oppression by reinforcing such stereotypes originally created during the years of American slavery, when White men sexually abused Black females, especially in the absence of fathers and brothers who were removed from their families through auctions (Cooper, 1892). In the same fashion, intersectionality theory demonstrates that most individuals – depending on their temporal, historical, and regional locations – could oppress or be oppressed in certain contexts or localities (Weber, 1998). In defining oppression, the Blackwell Dictionary of Sociology provides an apt description which states,

The concept of oppression points to social forces that tend to press upon people and hold them down, to hem them in and block their pursuits of a good life. Just as privilege tends to open doors of opportunity, oppression tends to slam them shut (Johnson, 2000a, p. 39)

In addition, the Brazilian philosopher Friere (1970) also stresses that in theorizing the concept of oppression, one must assume how the multiplicity of identities cannot be conflated into one homogenous entity, but instead involves a look at how all identities work together to inform its oppression.

Sixth, intersectionality stems from the need to promote social justice (Weber, 1998). Looking through a lens of intersectionality which takes into account the multiplicity of identities and the complexity of power relationships surrounding these identities at both the micro and macro levels allows one to take steps into transforming the rules, policies, and actions of individuals and institutions. This results in equitable allocation of political, educational, and economical resources among these groups.
Dill & Zambrana further outline intersectionality’s mission of social justice into four primary avenues: transforming knowledge to incorporate the marginalized individuals whose voice has been absent for so many years – referred to as “nonhegemonic knowledge production” (Dill & Zambrana, 2009, p. 17); relaying such knowledge in higher-level educational institutions as a way to revamp the curricula that teach inequities; applying this transformed knowledge to aid marginalized citizens in their daily lives; and using such knowledge to amend current public policies that benefit the dominant culture (2009).

Zambrana and Macdonald (2009) provide additional assumptions specifically to address intersectionality research in their study on African-American and Mexican-American women in higher education. Such assumptions are also easily applicable to K-12 schools. Zambrana and Macdonald state that the mutually constituted identities of African-American girls inform educational opportunities and experiences for these students. These identities are also crucial in determining school policies and the acquisition of academic resources in public schools. Zambrana and Macdonald discuss the role of structural gatekeepers in causing educational segregation – both in the classroom and in the school – and the prevention of opportunities for academic readiness to higher educational institutions. Also, teachers and administrators may hold negative stereotypes about African-American girls that affect how they teach science and, consequently, how these girls learn and engage in science (Atwater et al., 2010; Zambrana & MacDonald, 2009). More broadly, “institutional factors” play a key role in affecting how students engage in science (Zambrana & MacDonald, 2009, p. 234). With this point, Zambrana & MacDonald suggest that the role of teachers is one key example.
Although they do not elaborate with this tenet, one assumption could be that the authors are thinking of the normative role of the teacher as an authority figure that may disengage students (Atwater et al., 2010; Driver et al., 2000). One example from Berland (2011) and Berland and Reiser (2011) show that the urban students in their White teacher’s class seemed disengaged in the curricula of the class – though followed all of her directions in a quiet manner. However, students in another class led by a Black teacher seemed fully engaged in learning argumentation.

Though pioneered as a gold standard in the social sciences, intersectionality does run the danger of becoming just another buzzword (McCall, 2005). This is due to the methodological challenges that exist in using this framework (Bowleg, 2008; Choo & Ferree, 2009; Hancock, 2007; McCall, 2005; Winker & Degele, 2011). However, some have attempted to circumvent these issues in their own fashion (Choo & Ferree, 2009; Winker & Degele, 2011). One way is by creating research that is informed by intersectionality theory (Brah & Phoenix, 2004; Cronin & King, 2010; Nash, 2008).

Literature on intersectionality theory reveals that evaluating African-American girls’ use of argumentation with this framework would benefit by studying the various identities of African-American girls, how they intersect for each student, and what these intersections would look like in their ability to form scientific arguments. One way to study these intersections is through their use of lived experiences that emerges from their social location (Hill Collins, 2000). On a slightly broader scale, the intersection of these identities in the science classroom may help inform how these girls navigate their science identities by way of science discourse such as argumentation in a classroom environment.
1.4.8 Power relationships

Because issues of race, gender, and class are entangled with the oppression and privilege that pervades our society, it is important to also discuss power relations as viewed in Black feminist thought and intersectionality theory (Hill Collins, 2000; Weber, 2001). These comparable theories view power relations in two different ways. In one, power can be viewed as a “dialectical relationship” between oppression and activism (Hill Collins, 2000, p. 274). However, particularly noticeable within both theories is the view of power as a dynamic process related to the “matrix of oppression” from which it emerges (Davis, 2008; Hill Collins, 2000, p. 274). In this sense, the dynamics of power relations represents a Foucauldian lens (Davis, 2008). That is, power relationships are not fixed across contexts. In actuality, it is remarkably dependent on context. For instance, a Black woman may find that she feels oppressed based on class and or race when she is acquiring a new home. She may also feel oppressed sexually as a woman when viewing stereotypical music videos that highlight the Black Jezebel archetype – an exotic seductress (Hill Collins, 2000). Still, equally important is the assumption of the role of human agency (Hill Collins, 2000; Weber, 2001). That is, “…domination and resistance shape and are shaped by individual agency” (Hill Collins, 2000, p. 275). In this respect, a woman may rely on ways to resist the oppressive practices or stereotypes that she experiences in her daily lives.

Additionally, intersectionality theory helps to account for any undue influences power may play during data collection and analysis, by also accommodating “the theorist’s reflexivity [in] allowing her to incorporate her own intersectional location [during] the production of self-critical and accountable feminist theory” (Davis, 2008, p. 71).
Consequently, assessing all the various nuances of power while African-American girls learn scientific argumentation with a researcher that is mindful of her social location may provide invaluable information on the varying ways it is manifested in the science classroom.

1.5 Significance

The NRC created a conceptual framework in the hopes that students will one day graduate high school as scientifically literate citizens (2011). One of the most significant ways this may occur is by engaging students into the practices of science, such as argumentation (Driver et al., 2000; McNeill, 2011; McNeill & Pimentel, 2010; NRC, 2011). Teaching students to construct and evaluate claims and relate them to evidence also prepares them for the socio-scientific issues they will face throughout their lives (NRC, 2011).

However, argumentation, like other forms of science discourse, may also impede student learning for non-dominant groups such as African-American girls (Atwater, 1996; Brown, 2004; NRC, 2011). These students may face cultural conflict as their identities do not align with the traditional culture of science taught in the classroom (Atwater, 1996; Brown, 2004). Research shows that for successful implementation of scientific argumentation, teachers should immerse themselves in the everyday lives of students – especially members of non-dominant cultures – in order to best teach this language of science (NRC, 2011).

Current literature highlights the need to provide an inclusive science education for African-American girls, particularly in the scientific practice of argumentation. It demonstrates that in-depth analyses of their identities are imperative in engaging and
facilitating science learning for these students (Brown, 2004, 2006; Brown et al., 2005; Calabrese Barton, 1998; Carlone, 2004 NRC, 2011). Though current work is instrumental in bringing scientific argumentation to poverty-stricken communities, it neglects a deeper and more complex study into students’ lives (Berland, 2011; Berland & Reiser, 2011; McNeill, 2011; McNeill & Pimentel, 2010).

This research adopts a theoretical framework grounded in Black feminist epistemology, microethnography, and intersectionality theory (Dill & Zambrana, 2009). Providing such a lens in science education studies may inform teachers on the complex nuances of providing culturally relevant education to these students. In this sense, future generations could then include an increased number of diverse scientifically literate citizens and scientific professionals.

1.6 Definition of Terms

Underrepresented/non-dominant/historically marginalized groups – Individuals with the following heritage: Alaska Natives, Native Americans, Blacks or African Americans, Hispanics, Native Hawaiians, and other Pacific Islanders…” (National Science Foundation, 2008, p. 8)

Socio-scientific issues (SSIs) - “social issues with conceptual or technological ties to science” (Sadler, 2004, p. 513)

1.7 Chapter Summary

This research seeks to add to existing scientific argumentation literature by exploring how African-American girls use their lived experiences and social locations in their construction and evaluation of argumentation. The current body of scientific
argumentation literature lacks a lens that has been previously used in science discourse studies involving non-dominant students. This lens holds the assumption that cultural conflict occurs between students’ personal communities and the classroom culture of science. Hence, one must then understand the cultural background of these students in the hopes of effectively teaching scientific argumentation. To resolve the preceding issue, I proposed a framework grounded in Black feminist epistemology and intersectionality theory as a lens to examine the ways African-American girls may learn scientific argumentation for this study (Hill Collins, 2000; Weber, 2001; Zambrana & Macdonald, 2009). Black feminist thought necessitates the inclusion of African-American girls' lived experiences in order to better understand how they construct and evaluate scientific arguments, and how these lived experiences emerge from their various identities (Hill Collins, 2000). Intersectionality theory evaluates the simultaneously expressed identities of these girls framed in their socio-historical context while learning scientific argumentation in the classroom (Zambrana & Macdonald, 2009). Overall, this theoretical framework may inform teachers on ways to provide a culturally relevant education to African-American girls.

1.8 Organization of the Study

In this dissertation, Chapter 1 presented the introduction, statement of the problem, research questions, the significance of the study, and definition of terms. Chapter 2 contains a review of the literature relevant to science discourse and identity, argumentation, particularly socio-scientific argumentation, as well as argumentation students that focuses on underrepresented groups. The methodologies and research design
are presented in Chapter 3. The results and analyses of this study are presented in Chapter 4. Chapter 5 contains the discussion and interpretations of the study.
CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This literature review is divided into two sections. The first section discusses literature pertaining to science discourse with a focus on science identity for non-dominant groups. The next section discusses one subfield of scientific discourse, scientific argumentation, with a focus on socio-scientific issues (SSIs). A focus on non-marginalized groups in the studies occurs first. Following this, the focus is narrowed to include only marginalized students.

This literature review began with a perusal of the new National Research Council’s (NRC) conceptual framework found online through a Google search (NRC, 2011). From this framework, all articles and books included in the review were found initially using the Scopus and Proquest databases. Due to the heavy volume of material, most of the articles included in this review – specifically scientific argumentation, socio-scientific argumentation, scientific argumentation for marginalized groups, identity, and intersectionality, are the most heavily cited articles in these databases. In addition, I performed an extensive search through the Journal of Research in Science Teaching, Science Education, and International Journal of Science Education for other relevant articles to these main topics in this review: scientific argumentation, identity, and intersectionality. I relied on references of these articles at times to clarify points and receive further background information. The work reviewed in this literature review contained only peer-reviewed, scholarly journal articles, reviews, and books.
2.2 Critical Review of the Literature

2.2.1 Science discourse, identity, and non-dominant groups

2.2.1.1 Introduction

This section will focus on studies relevant to science discourse. Because of the wide breadth of studies on this topic in science education literature, the review will only center on those that are related to non-dominant or underrepresented groups. Abundant in this area of science discourse literature is the discussion of science identity (and other types) that propagated research relating to science discourse among marginalized groups. In this section on identity, I will include the critical reviews pivotal to my research.

2.2.1.2 Identity

Although identity is prevalent throughout literature dating back to the 1890s, the topic of identity in social learning has exploded in the last decade or so, in part, due to the work of feminist scholars (Brickhouse, Lowery, & Schultz, 2000; Brickhouse & Potter, 2001; Calabrese Barton, 1998; Haraway, 1986). In educational literature and beyond, researchers have been particularly concerned with social identity – how one identifies themselves with regards to their group membership (Calabrese Barton, 1998; Brown, 2004; Brickhouse & Potter, 2001; Carlone & Johnson, 2007). In the field of science education, the processes in which a student develops their science identity in relation to forming their other types of group identity (i.e., race, gender) have been explored (Brickhouse & Potter, 2001; Brickhouse et al., 2000; Brown, 2004; Carlone & Johnson, 2007).
Erik Erikson created the most popular framework among many psychologists and social scientists in the 1950s and 60s (Brown, 2004) with his nine-stages of psychosocial development. During identity formation, an individual undergoes psychological changes in their development by undergoing a crisis. The person resolves that crisis by encountering positive elements that are more prevalent than negative ones. Resolving a crisis in each of the nine stages is “a life-long struggle” but necessary for the individual to adjust well in their life (Brown, 2004, p. 782).

Erikson’s theory of identity formation focuses more on personality of an individual (Simanowitz and Pearce, 2003). This type of identity, known as personal identity, highlights the characteristics of an individual that are individualistic to him or her (such as being smart and highly detailed). Although crucial in the development of a child, personal identity omits major social components in identity development, particularly when exploring interactions in settings such as the classroom where discourse is essential for identity formation (Brown, 2004). Furthermore, psychologists such as Valsiner (1989) state that culture play a crucial role in a child’s development (Atwater, 1996). Atwater synthesizes such points succinctly by stating the importance of such relationships “students’ cultural realities, including concepts of self and social roles, are constructed through social interactions” (1996, p. 825).

2.2.1.3 The importance of identity in science education

Scholars in the field of science education realized the value of research exploring student identity formation during the last decade (Brickhouse et al., 2000; Brown, 2004; Calabrese Barton, 1998). Research drew from work outside the field of science education. Accordingly, definitions of identity prominent in this literature are
commensurable with other disciplines. Identity is described as a process that develops through contextual interactions, highlighting such exchanges as necessary with “social others” (i.e., peers and teacher) during identity formation (Hand & Nasir, 2006; Tan and Calabrese Barton, 2007). These interactions are fluid and dynamic; another component of identity (Brickhouse & Potter, 2001; Brown, 2004; Gee, 2001). Brickhouse and Potter further underscore the social aspect of the definition of identity, stating that it is “[the] ways in which one participates in the world and the ways in which others interpret participation” (2001, p. 966).

The benefits of evaluating identity can be found from many perspectives. From the researcher’s viewpoint, the process of forming an identity allows one to view students as agents in their classroom (Brickhouse et al., 2000). An agent is one who resists the structural confines set forth by society, adopting a perspective that focuses more on equity in the classroom (Carlone & Johnson; 2007). Hence, there is a general consensus in literature that emphasizes identity as not merely being determined by structure but acting relative to it (Brickhouse et al., 2000; Carlone & Johnson, 2007).

Additionally, learning theorists have an important advantage in studying science identity as its development is crucial for scientific learning (Brickhouse et al., 2000, Brickhouse & Potter, 2001; Carlone & Johnson, 2007; Olitsky, Flohr, Gardner, & Billups, 2010). A student’s ability to form science explanations, for example, is correlated with how effective they develop a cohesive science identity in their school (Brickhouse et al., 2000; Olitsky et al., 2010). Additionally, for successful student learning to occur, students must be able to form identities that are “compatible” with
science identities (Brickhouse et al., 2000, p. 443). The latter involves taking into account all the social communities of the child.

Carlone and Johnson further highlight several arguments regarding the need for novel identity research in science education (2007). One argument suggests that understanding identity is an additional way for researchers to view teaching and learning in a different light. An example of this involves studying the kinds of people that are actually doing well in a current teaching practice versus those that are not.

The second argument described in Carlone and Johnson’s paper focuses on the need to understand how a student learns. As noted previously, proponents of this perspective understand that science has its own “norms and discourse practice” (Carlone & Johnson, 2007, p. 1189). However, science discourse, usually not a problem for middle or upper-middle class families whose language styles are similar, can be problematic for those who do not speak the same language (NRC, 2011). Brown further clarifies this point by stating that teachers and researchers must first recognize that students have their own discourse which could make their ability to learn scientific concepts extremely challenging (2004). This type of identity, coined discursive by Brown, is made more complex by its ever changing component in response to the dynamic minutiae of a classroom setting: peers, small group versus classroom discussion, and the various scientific concepts discussed (Brown, 2004). Research shows that using a student’s own discourse to relay scientific concepts has been more effective with facilitating science learning (Brown, 2004; NRC, 2011).

The third argument focuses on the issue of equity in the science classroom (Carlone & Johnson, 2003). By using a personal example of teaching science to homeless
urban school children in an after-school program, Calabrese Barton brilliantly illustrates the problems that arise when science education’s goal of a “science for all” pedagogy and curriculum clashes with a teacher’s need to teach science as lying “…in the center, as a target to be reached by students at the margins…” (1998, p. 391). Though this study will be explored in a subsequent section, Calabrese Barton argues that focusing on identity involves acknowledging the students’ lack of housing, economic difficulties, and racial and ethnic backgrounds into her pedagogical approach (1998). In this way, science is made accessible beyond the traditional classroom (1998).

Thus, scholars in the field of science education recognize the importance of incorporating an identity lens in understanding the backgrounds of students, how their personal lives may constrain or facilitate their science identities, and the promise of such findings to aid in providing a more equitable curriculum. This involves transforming normative classroom practices into novel techniques that promise to successfully engage marginalized students into the world of science.

2.2.1.4 Current research on identities in science education

Science identity is multifaceted, particularly when taking into account physical, cultural, and social characteristics such as race and gender (Brickhouse et al., 2000; Brickhouse & Potter, 2001; Carlone & Johnson, 2007). The latter years of the feminist movement motivated these issues relating to simultaneously expressed identities. Surprisingly, the field of science education has been questioning ways in which a student’s race, class, and gender identities shape their means to learn science for over 20 years (Atwater, 2000; Baker, 2002; Gallagher & Anderson, 1999).
Emerging work beginning in the late 1990s also reflects a move towards a student’s socio-economic background in science education literature (Calabrese Barton, 2001; Calabrese Barton & Tobin, 2001). Prominent in these studies are the notion that evaluation of diversity within genders, notably involving girls of color, is necessary (Atwater, 1998; Brickhouse, Lowery & Schulz 2000; Brickhouse & Potter 2001; Calabrese Barton 1998, 2001). Prior to this, scholars challenged others to use a more critical lens in evaluating science education. This involved breaking down the androcentric view of knowledge to include the multiplicity of social identities from non-dominant groups (Atwater, 1996). Atwater further states that this view of science is “shaped by social, political, cultural, economic, ethnic, and gender values” (Atwater, 1998, p. 375). Research from critical and feminist epistemologists, philosophers of science, and other feminist scholars also challenged science researchers and educators to create a more equitable curriculum. This included exploring and devising pedagogical strategies that reflect how identities coalesced within the structural confines of schools and higher institutions (Brotman & Moore, 2008; Calabrese Barton, 1998; Carlone & Johnson, 2007; Johnson, 2007; Potter, 2006). Scholars in this field perceived these schools as institutions in which societal rules dictate the dynamics of learning (Atwater, 1998). As Calabrese Barton remarks on critical and a feminist lens in accordance to classroom practices,

…pedagogy involves the production of knowledge, culture, and identities… [t]his means the production of power, culture, and identity is a historically, socially, and politically situated process that is inherently subjective. In the case of science education, this means that pedagogy involves the production of scientific knowledge which in its broadest sense includes, content, process, and discourse…because of the situated nature of pedagogy, knowledge construction about science and self-within-science occur within and are shaped by the relational space of the social, historical, and political (1998, p.380).
Brotman and Moore designated four themes in science education research that were concurrent with the three waves of the feminist movement (2008). The first progression of feminism coincides with studies published in science research journals during that period that promoted equitable access to science education. The second wave focused more on studies which sought to alter the curriculum or pedagogy of science. The third wave of feminism involved a close evaluation into how race, class and gender intersect and where research adopts a more activist approach to science education. This is highly significant because national educational organizations and science education researchers now consider the focus on race, class and gender as one crucial step in ensuring science literacy for all (NRC, 2011). In the last decade, researchers have found that analyzing identity in education is a highly informative approach to evaluate the ways that both students’ and teachers’ race, class, and gender affect science learning in the classroom (Brickhouse et al., 2000; Brickhouse & Potter, 2010; Brotman & Moore, 2008; Brown, 2004; Carlone, 2003; Johnson et al., 2011; NRC, 2011).

2.2.1.4.1 Calabrese Barton (1998).

In a pivotal study that emphasizes the necessity of acknowledging all identities of children when teaching science, Calabrese Barton offers her own personal experience of teaching female homeless children (1998). One primary theme in this study is that acknowledgement of the various social identities is necessary in understanding how to best teach all students. If gone unnoticed, cultural conflict may result (Atwater, 1996; Brown, 2004, 2006; Brown et al., 2005).

In this study, Calabrese Barton, a proponent of urban science education, first cites statistics on the plight of homeless children to help argue for the need of teaching an
inclusive education to all children (1998). At the time of her study, fifty percent of these students did not attend school (Calabrese Barton, 1998). Indeed, at the time of this review, 1 in 45 children were considered homeless in the United States (National Center on Family Homelessness, 2011).

To frame her study, Calabrese Barton provides historical background on the models that persist in literature on minorities and women – the deficit and inferior treatment models (Calabrese Barton, 1998). Although the former focuses on the underperformance of minorities and women, the latter model centers on these groups as having “…multiple ways of knowing…” (Calabrese Barton, 1998, p. 382). This sentiment is commensurable with other feminist scholars (Haraway, 1986). Calabrese Barton contends that feminist social constructivists in science education stress the biases that result in science practices when other educators are not mindful of the multiple ways students may acquire scientific knowledge (1998).

Figure 1 depicts my adaptation of her theoretical framework framed in feminist social constructivist theory (Calabrese Barton, 1998). It outlines the role of pedagogy in the classroom, and the various influences that exist, both on the part of the teacher and the student (1998). Pedagogy involves the construction of scientific knowledge and encompasses scientific content, process, and discourse (Calabrese Barton, 1998). However it is also embedded in various values and beliefs both on the parts of teachers and students. It follows that pedagogy encompasses how science is represented – or what science is made to be in the classroom. The ways a teacher represents this assigns power to the teacher and can influence how a student forms their science identity. However, the relationship that exists is essentially power vs. actuality because the student has agency
(1998). In regards to the latter point, children can choose to accept how science is represented to form their own identity or reject that model in creating their own identity. Calabrese Barton offers a powerful consequence in this framework, that “…we need to think about how children perceive themselves within and outside of science, and the choices they make because of those perceptions ([emphasis in original] 1998, p. 382),

![Diagram]

**Figure 1** Calabrese Barton’s pedagogy in the classroom

Calabrese Barton’s goal is to demonstrate the premise of science for all among urban homeless children (1998). She emphasizes the ways student agency may aid how these children identify with science (1998). The research setting is not in the normative classroom, but in a homeless center where she performs after school science sessions for two years. She uses an interactive ethnographic approach, because she seeks to immerse herself into the lives of these students (Anderson, 1989). Yet, it is also a form of action
research, where she consistently reflects on her practices and changes her lessons based on the feedback from the study participants (Calabrese Barton, 1998).

There are three students that are the focus of her study in this paper (Calabrese Barton, 1998). Gilma is a Mexican girl with explicit social and sexual identities that surface while she is learning science lessons. Patrice and K’neesha are two sisters. Patrice is considered the smart one (in the normative sense) while her older sister, K’neesha is considered learning disabled and has been transferred to an alternative school for other kids with similar disabilities.

Commensurable with an ethnographic approach, Calabrese Barton relies on the typical methods of researcher – field notes, videos and audiotapes of the shelter’s science lessons, and interviews with both the children and parents/guardians at the shelter. She also relies on any student written work and her own teaching journal – sources that are also reminiscent of an action research project. Ethnographic approaches are typically lengthy for several reasons, including establishing a rapport with the students, teachers, parents, etc. (Anderson, 1989). Hence, this project took place over the course of the school year. Data analysis involved the use of feminist themes relating to identity and representation – though no detailed explanation of these themes were given in this article.

Calabrese Barton’s findings in this study are significant. Her conclusions essentially connect lived experiences as found in other feminist literature of these students with the teaching and learning of science (Calabrese Barton, 1998, p. 389). Through various events in her research, Calabrese Barton finds that the students in her study practiced their scientific skills in the context of these lived experiences. For instance, the students decided to study the pollution occurring in the dangerous urban
area surrounding their shelter, creating investigations that were relevant to their daily lives. In these ways, the girls seemed to thrive in the ways that they constructed scientific knowledge in this context. In this way, Calabrese Barton contends that these events “removes the binary distinction from doing science or not doing science and being in science or being out of science“(1998, p. 389). She emphasizes the reflexivity of both science and lived experiences by way of the previous example of pollution. That is, the pollution found around the homeless shelter helped shape the participants’ views of science and vice-versa (Calabrese Barton, 1998).

Calabrese Barton concludes that all teachers must be mindful of how they represent science inside and outside of the classroom and how it may interact with the student’s science identity. Specifically, understanding that children have “multiple ways of knowing and doing science which are reflective of the social, historical, and political context…” is necessary in order to ensure that science is for all (Calabrese Barton, 1998, p. 382).

2.2.1.4.2 Brown, 2004.

Similar to the lived experiences discussed by Calabrese Barton and other feminists (Calabrese Barton, 1998; Hill Collins, 2000), Brown uses the phrase “home cultures” to describe student’s personal lives in a successful attempt of emphasizing the cultural conflict resulting between the former and school science (2004, p. 810). In his study on urban high school students, the conflict occurs with the school curriculum, identities, and language. These can be explored from both micro and macro perspectives. The former involves student agency, how one decides to act in the classroom because of
this conflict; or on a macro level which looks at a particular group as a whole. Brown’s emphasis is on the micro level in his study.

Brown employs a framework that seeks to resolve the vagueness of identity (i.e. personal or social, etc.) by focusing on Gee’s definition which includes how a student is viewed and considered in her own context (2004). In the context of science, it is then based on how others recognize the student as being in science. Identity formation, as described by Brown, also occurs in “micromoments” – it is ever-changing but still rooted in a socio-historical context (2004, p. 818). In order to define his discursive identity theory, he describes discourse as the means of displaying how one wishes to be “perceived” (Brown, 2004, p. 812). Discursive identity then relies on student agency, where “political, ethnic, and cultural” identity conflicts with school science (Brown, 2004, p. 813). Brown’s objective in this study, then, is to examine the constructed discursive identities of urban students and their influence on student performance.

The methodology is ethnographic, as is Calabrese Barton’s study (1998). Brown’s research occurs in the classroom where he is, at the time, a full-time teacher to 9th to 11th graders, instructing biology and the life sciences over the course of one school year. Also aligned with an ethnographic approach, he uses videotapes, interviews and student writing to study discursive identities. His data analysis, however, focuses on the language used in the classroom and is termed sociolinguistic discourse analysis. He begins his analysis by searching through various discursive activities during the school year through videotapes. He seeks evidence based on cultural cues which involves not only discourse, but the behavior and thoughts of these students. He then assesses the cultural meaning of these social interactions by evaluating phase, sequence, message, and action units.
Brown (2004) delineates these types of units in his study which organizes the components from broad to narrow. Phase units encompass both the words and activities of the students and are marked by linguistic and non-linguistic types of behavior. Sequences occur within phase units and signify changes of activity for each student. Message units consist of individual utterances, intonation and pitch changes, etc. Action units provide the meaning involved in each message unit. In this sense, they provide the “secondary message” and as the name implies, can be non-verbal (Brown, p. 816).

Brown found that the students in his class adopted different discursive identities, yet they transitioned throughout the year (2004). These identities stemmed from cultural conflict and through affiliation with other peers. The four types determined by Brown were oppositional, in which the student avoided all attempts at science discourse; maintenance – in which the student used discourse, but only the minimal amount needed to maintain the discourse from their home cultures; incorporation – where some mastery of science discourse occurred or the student made a concerted effort to implement it into their daily talk. Lastly, proficiency discourse indicates that the student mastered science discourse in their classroom activities everyday in the classroom.

Like Calabrese Barton, Brown concluded that students use agency when learning science (Brown, 2004; Calabrese Barton, 1998). In his case, this involved the language of science. Most importantly these discursive identities were not fixed, but contained a dynamic component, implying that the language of science can still be taught mindful of these findings.
2.2.1.4.3 Other studies on identity and science discourse.

Other studies in science education focus on the complex interaction of ethnic, cultural, socio-economic, and gender identities. Brickhouse et al. highlight the notion that African-American girls can acquire “multiple social identities” (2000, p. 287). That is, researchers and teachers must understand that beyond differences in racial or ethnic makeup, these girls can be athletic, adopt a good girl persona, resist classroom science, etc. (Brickhouse et al., 2000). For example, Brickhouse et al. found that although the participants in her study were similar in race, sex, and other factors, these were not accurate determinants to describe their science identity, pointing out that one African-American girl broke “certain gender conventions” (Brickhouse et al., 2000, p. 451). Indeed, studies like these (Brickhouse et al., 2000; Brickhouse & Potter, 2001) discuss the need for further research focusing on the differing ways that African-American girls and other girls of color form their science identity while simultaneously forming their other social identities.

The role of researcher reflexivity is also noted in other studies of science identity and discourse. In a study by Calabrese Barton (2001), the focus is on two fourth grade Mexican-American girls and their disillusionment with traditional school science. Calabrese Barton proposes critical ethnography as a methodology grounded in social constructivism but “focused on participatory critique, transformation, empowerment, and social justice” (Calabrese Barton, 2001, p. 905). This method is necessary and unique in that it allows her to make observations in ways that are constantly reflexive of differing power dynamics (White female professor versus poor urban Mexican-American girls) (Calabrese Barton, 2001). It highlights the ways these dynamics may cloud the critical
lens she uses to evaluate their attitudes on science. This continual reflection on her part allows her to understand her initial misinterpretation of their refusal to raise hands from being “bullied into their silence” by male classmates to actually signifying “intentional acts of resistance” against the White hegemonic power structure. (Calabrese Barton, 2001, p. 909).

2.2.1.4.4 Summary.

Areas of contemporary science education literature reflects a more confident stance on the roles of science identity; with research taking a more critical approach and with social justice as its goal (Brotman & Moore, 2008; Brown, 2004; Calabrese Barton, 1998, 2001; Carlone, 2004; Carlone & Johnson, 2007; Johnson, Brown, Carlone, & Cuevas, 2011). Prominent themes in this research, as seen in previous sections, are the importance of the student’s agency and identities that dictate how she navigates scientific knowledge, both in its practice and content (Brown, 2004; Calabrese Barton, 1998, 2001; Carlone, 2004). Normative practices also emphasize that pedagogical, classroom, or school practices are not aligned with students’ backgrounds, resulting in cultural conflict (Brown, 2004; Calabrese Barton, 1998). While these findings are promising in evaluating science identity, literature still resorts to the “simplistic and essentialist binary oppositions between “girls” as one unitary group and “boys” as another” (Brotman & Moore, 2008, p. 990). Some studies focusing on classroom discourse scarcely mention the notion of gender and the multiplicity of these identities (Brown, 2006; Emdin, 2010; Gilbert & Yerrick, 2001; Reveles, Cordova, & Kelly, 2004). Literature that does explicitly question the intersections of race, gender, and class with science neglect to provide an extensive exploration of these intersections (Olitsky, 2007).
2.2.2 Scientific/socio-scientific argumentation

2.2.2.1 Introduction

In this section, I will critically review studies relating to scientific argumentation. Because my research project will involve socio-scientific issues (SSIs), these reviews will only involve argumentation studies that focus on these types of issues, with the exception of those with underrepresented students as participants. The latter is due to the scarcity of such studies involving this demographic group. Yet, these studies must be discussed in light of my own research interests.

In order to frame these reviews, I first offer definitions and types of arguments in argumentation. It is necessary for ease of discussion to use these terms interchangeably at times. Following this, I will introduce one common argumentation model, the Toulmin model. This discussion will involve critiques of the model posed in the literature as well as the concept of this model as being socially situated. From there, I will introduce argumentation and SSIs and critically review articles that utilize their own models in relation to SSIs. The discussion of models in these article reviews are not exhaustive but provide information on how other scholars seek to frame the construction of arguments.

2.2.2.2 Defining scientific arguments and argumentation

The process of argumentation carries with it various meanings across disciplines (Garcia-Mila & Andersen, 2007). Within the realm of science education, scholars agree that acquiring scientific knowledge is not an absolute and undisputable process (Driver et al., 2000). This facilitates a consensus on the definition of argumentation as the everyday
practice of constructing arguments. However, defining scientific argumentation has proven to be complex; reliant on different perspectives and research interests.

Driver, Newton and Osbourne define and delineate two types of arguments in scientific argumentation (2000). One type of argument common in schools is a rhetoric or didactic type of argument (Driver et al., 2000). This type involves teachers using scientific explanations in the classroom and is typically one-sided, not necessitating a counter response. However, the problem arises when the teacher does not rely on “rational authority”, in which he or she pronounces evidences for claims made in the classroom (Driver et al., 2000, p. 591). Instead, he or she often resorts to “traditional authority”, which involves relying on the support of the institution or school, and which eventually results in a lack of presentation of evidence on the part of the instructor (Driver et al., 2000, p. 591).

A second form of argument is known as a dialogical, dialectical argument or multi-voiced argument (Driver et al., 2000; Jiminez-Aleixandre, 2007; Patronis, Potari, & Spiliotopoulou, 1999; Tippett, 2009) and considers alternative views or perspectives. Jimenez-Aleixandre differentiate between the altering views of more than one individual and the differing perspectives ruminating in one student’s mind, leading to “meaning-making” (2007, p. 94).

Building off this definition of a dialogical argument, Bricker and Bell describe arguments as a social practice that uses claims and allows for the refutation of these claims (Bricker & Bell, 2008). Tippett adds to the growing body of definitions by framing arguments as analytical tools, with the resulting constructs relying on the rules of logic which are inductive or deductive in nature. Tippet further defines inductive
arguments as including “analogies and causal correlations, while deductive arguments include syllogisms and causal generalizations” (2009, p. 17)

Current literature also reflects argumentation as dependent on the criteria used for analyzing the arguments (Bricker & Bell, 2008; Garcia-Mila & Andersen, 2007; Duschl 2007), such as formal logic. For instance, in formal reasoning, supporters look to deductive validity, in which premises lead to a conclusion. Bricker and Bell state that even at present, many scholars believe this type of argumentation to be a “gold standard, so to speak, of argumentation” (2008, p. 476). Perhaps this is due to the origins of the tradition, in which Plato’s version of formal logic is currently practiced today (Bricker & Bell, 2008).

However, many believe that this type of validity is outdated because such an argument fails to address the “elements of everyday argumentation” (Bricker & Bell, 2008, p. 477; Garcia-Mila & Andersen, 2007). According to Bricker and Bell, this embodies the essence of scientific argumentation itself due to its social nuances (2008). These types of arguments rely on the justification of a belief. Researchers then use “warrants as a “central role in the justification by connecting data with claims; allowing qualifying adverbs such as “usually” and “presumably” (Garcia-Mila & Anderson, 2007, p. 31).

The types of definition by various scholars emphasize the notion of argumentation as embedded in informal reasoning (Osborne & Patterson, 2011; Sadler, 2004). It follows that, like informal reasoning, arguments rely on being able to support premises to reach a “tentative conclusion” (Osborne & Patterson, 2011, p. 634). In other words, justification of a claim is dependent on the evidence, which involves the use of
warrants and data. (Osborne & Patterson, 2011, p. 634). The individual posing the argument must then supply sufficient warrants that provide support to a claim, making it a “justified belief” (Osborne & Patterson, 2011, p. 634). Argumentation also involves persuasion (Garcia-Mila & Anderson, 2007). The resulting constructs may then be characterized and evaluated using criteria that focus on quality, such as “soundness, plausibility, and persuasiveness of the audience, in addition to deductive validity” (2007, p. 31).

Although science educators state that one reason for introducing students to the practice of argumentation is to expose them to the practices of science (Driver et al., 2000), this skill set may promote negative connotations which are misconstrued, particularly when considering this practice as a scaffold to learning in the science classroom (Duschl & Osborne, 2002). Duschl and Osborne (2002) claim that just the notion of argumentation incites tension and confusion between those that partake in it. This is because winning an argument is viewed as a goal versus a skill-building practice most often used in the normative classroom or as “a social and collaborative process necessary to solve problems and advance knowledge” (2002, p. 41). Put differently, scientific argumentation as a classroom practice should promote the advancement of scientific knowledge – and not to be used solely as a discourse tool for debates in class.

Another issue coming forth in recent years is the existing overlap between an argument and a scientific explanation that has somehow blurred the meaning of the two terms (McNeill & Krajcik, 2008; Osborne & Patterson, 2011). Some of the confusion may be due to practices that seek to justify explanations because of the many existing explanations used to describe one type of phenomenon (Osborne & Patterson, 2011).
Osborne and Patterson wrote an article delineating the meanings behind both practices, stating,

If a field lacks clarity about the concept that it seeks to explore and promote as a feature of classroom practice, then it will fail to communicate its meaning and intent to the wider audience of curriculum developers, standards developers, and teachers (2011, p. 628).

Osborne and Patterson make the distinction by describing a scientific explanation as “making sense of a phenomenon based on other scientific facts” (2011, p. 629). Thus, explanations seek to help answer questions by describing how the phenomenon originated. In arguments, however, the main goal is to justify a claim or statement regarding phenomena with evidence; hence, relating that evidence to the claim.

Arguments are also tentative, so that altering views can be proposed as well. Osborne and Patterson relate the two practices together by stating that “explanations are judged, however, by arguments about the extent to which they are coherent, plausible, and comprehensive” (2011, p. 629). Sampson and Clark, agreeing with similar authors, situate arguments in the science classroom and describe arguments as “artifacts that students create to articulate and justify claims, explanations, or viewpoints” (2008, p. 448). Duschl and Osborne (2002) further clarify the relationship by claiming explanations require students to help understand their thoughts, provide examples and note any gaps in these explanations. In this sense, an argument will help bridge these gaps by linking evidence to “models or theories” (Duschl & Osborne, 2002, p. 44). Duschl and Osborne helpfully demonstrate this by describing an example of an individual who must explain to a skeptic that changing from day to night to day again are due to the Earth’s rotation, not the Sun’s movement. Explaining this requires using the core practices of an argument. Hence, to make a belief justified or rational, the individual must impart the use of data
and warrants. To help ensure that students are effectively learning argumentation, however, the authors reiterate that explicit criteria must be defined in the science classroom that clearly outlines how a belief may be justified (Duschl & Osborne, 2002).

However, current literature also suggests that such a distinction does not exist between explanations and argumentation (Bricker & Bell, 2008). These scholars claim that argumentation is prominent in people’s explanations and, therefore, explanations have argumentative properties. For example, people often justify why their explanation should be counted as the correct statement as opposed to alternative views (Bricker & Bell, 2008, p. 478). Still, others look at the use of both terms in more of a logistical fashion, where negative connotations associated with the word argument may promote some trepidation on the part of the educator, resulting in using the word explanation instead (McNeill & Krajcik, 2008).

To summarize, the majority of existing literature points to the need to provide a clearly distinct definition to both terms, as to avoid confusion on the part of the participants in the study as well as the creation of misleading pedagogical methods.

2.2.2.3 Toulmin’s argument model

Toulmin’s theoretical framework was originally created beyond the field of science education, but its original model – as well as modified versions of it – is the most extensively used model in studying argument structure in science education (McNeill, 2011; McNeill & Pimentel, 2010; Sampson & Clark, 2008). Toulmin created his “domain-general” (Sampson & Clark, 2008, p. 449) theoretical framework on the premise that formal logic offers a “decontextualized” (Bricker & Bell, 2008, p. 480; Toulmin, 1958) view of argument. Toulmin was referring to previous scholars’ use of this type of
logic who presumed such arguments are independent from the context of where the argument takes place. This pronouncement signifies the difference between what are called substantial and analytical arguments (Toulmin, 1958). Toulmin’s framework originally served to provide an alternative lens in analyzing the structure of substantial or everyday arguments; promoting the use of arguments that are taking into account their surroundings (Bricker & Bell, 2008). Figure 2 contains a schematic of Toulmin’s model with an example I created using urban schools and marginalized groups to help conceptualize his framework (Toulmin, 1958). As one can see, Toulmin’s model contains six important components; the claim; or the original statement; data, that serves to support the claim. Included is a warrant – a statement used to justify or make a connection between the claim and the data. There is also a qualifier – a phrase that supports a warrant. A backing is the “general condition that strengthens the acceptability of the warrants so that the connection between the data and the claims will not be questions” (Sampson & Clark, 2008, p. 451). Lastly, there is a rebuttal, a statement that serves to dispute warrants.

The use of Toulmin’s argument pattern has stirred up interesting topics when viewing current literature. Many researchers in the science education field still commonly use Toulmin’s model in analyzing the structural patterns of students’ arguments (McNeill, 2011; McNeill & Pimentel, 2009; Sampson & Clark, 2008). Such authors have found that students do not sufficiently use warrants and backings to help substantiate claims with their data.
Figure 2 Example of Toulmin's argument pattern using marginalized groups
However, some complications arise with using Toulmin’s model. First, arguments must be field dependent (Bricker & Bell, 2008; Sampson & Clark, 2008). This has created tensions between what Toulmin asserts is criteria for his model and what scholars insist his framework should be primarily used for – the structure of an argument. Sampson and Clark, themselves note that such components can easily be applied to other fields, making it “field-invariant” (2008, p. 452).

Second, many claim that this model does not provide a coherent way to assess the content of the argument (Driver et al., 2000; Nielsen, 2011; Sampson & Clark, 2008). That is, students may use the structure of the argument and explicitly provide examples of each model component. However, the summation of these parts may not lead to a coherent and sound argument. For example, does the data students use actually support the claim? What sort of data are the students’ relying on to justify their argument? Can the students provide sufficient warrants (or justifications) to make the appropriate connections between the data and the claim?

Following its difficulties on identifying coherence of an argument, educators who use this model as a way to assess the process of argumentation, particularly dialogical argumentation, have found significant problems (Driver et al., 2000; Nielsen, 2011). Driver et al. (2000) further mentions that “no recognition is given to the interactional aspects of argument as a speech event, or that it is a discourse phenomenon that is influenced by the linguistic and situational contexts in which the specific argument is embedded” (p. 294). The authors provide examples of the consequences of using this model; a claim or its justification could have a different meaning depending on the context; some parts of Toulmin’s model are not evident in an argument; and discourse is
not just verbal but also non-verbal – including such actions as gestures, “nodding, etc., especially in science where manipulatable objects are used” (Driver et al., 2000, p. 294) also note that group dynamics cannot be accounted for by this model. The complexity of this type of dynamic, as will be seen in a subsequent section, play a significant role in how students construct arguments and the composition of the argument itself.

It is due to the difficulties of using such a framework, that several scholars have used modified versions of the Toulmin model to aid in their research. McNeill and colleagues (McNeill, 2011; McNeill & Krajcik, 2008, 2012; McNeill & Pimentel, 2010) altered this model to contain only the components of claim, evidence, reasoning, and rebuttal. The reasoning provides the justification of the evidence to the claim. Driver et al. (2000) mention that some choose to describe in detail the argument itself as a way to analyze dialogical argumentation.

Nielsen states,

But the trend of the use of the Toulmin model for making dialectical interpretations is a manifestation of a deeper-rooted problem. Within argumentation theory and philosophy, it has been argued that the monological view afforded by the Toulmin model cannot meaningfully be applied to the complex dialogic dynamics of everyday argumentation (2011, p. 14)

Nielsen thus claims that if one is to use the Toulmin model in a study for dialogical argumentation, one must use this framework in accordance with another model to expound on the particular subtleties involved in the argumentation process.

2.2.2.4 Toulmin and socially situated argumentation

Previous research does raise several important questions when considering Toulmin’s model as a tool in research. However, while some authors highlight Toulmin’s supposed flaws in exposing the meaning of context in an argument, Bricker and Bell
(2008) suggest otherwise. These authors assert that the utilization of this model to analyze argument structure may have caused an assumption that context \textit{a priori} need not be a consideration; posing the burden more on the users of his model than Toulmin himself (2008). Instead, Toulmin’s original intent, they remind us, was to create an alternative model that accents the need of argumentation as being socially situated.

The premise of argumentation or any form of discourse as being “\textit{socially situated}” – reliant on the culture and social settings of individuals involved in such an interaction (emphasis on the original, Driver et al., 2000, p. 294) stems back several decades from the days of Kuhn, Feyerband, and feminist philosophers of science (Driver et al., 2000; Haraway, 1986; Longino, 1990; Sandoval & Millwood, 2005). For instance, the feminist philosopher of science Longino (1990) argues that justification of claims involve standards set by the community. However, she also insists that such standards must be embedded in diverse viewpoints within the community, outlining the socially situatedness of these standards. Longino is famous for outlining rules of practice that a scientific community should follow in which contextual values of scientists and the social aspect of knowledge are taken into account. Such rules, she claims, will result in a stronger form of objectivity (Anderson, 2011; Longino, 1990; Potter, 2006).

Bricker and Bell (2008) argue that Toulmin’s goal in scientific arguments demonstrates that “having a personal stake in one’s work is not at issue because scientists argue solely to build sound theories for the collective good of the enterprise” (p. 481). However, Longino acknowledges that such personal values do exist (1990). The scientific must also “take active steps to ensure that alternative points of view are developed enough to be a source of criticism and new perspectives” (Potter, 2006, p.
120). This requires input from marginalized groups; or such exclusion is deemed a “cognitive failure” (Potter, 2006, p. 120).

Bricker and Bell state that Toulmin “highlights the socio-cultural nature of argumentation but…that central piece of his theory seems to have gotten lost and instead, the “Toulmin model” has been reified and applied liberally “as a general heuristic” (2008, p. 485). The authors further argue that “Toulmin himself calls for empirical studies of argumentation, including historical and anthropologic accounts” (Bricker & Bell, 2008, p. 485). With this, Bricker and Bell suggest the field of science studies as a means to support Toulmin’s belief in argumentation. They define science studies as “an interdisciplinary field consisting of scholars from philosophy, anthropology, rhetoric, history, and sociology, who are interested in studying the processes and products of science, as well as the scientists engaged in this work” (Bricker & Bell, 2008, p. 479).

Bricker and Bell also paraphrase Prelli, an expert in rhetoric communication, whose ideas falls in line with the feminist Longino (1990).

Context and audience matter when examining what a community counts as reasonable, which he believes is socioculturally and historically situated. Standards of reasonableness (versus the truth of the argument) determine how arguments are critiqued and evaluated, as well as what community members will count as claims in the first place (2008, p. 485).

Bricker and Bell (2008) underscore Toulmin’s true intent – the need to evaluate more than just the argument itself, but the *arguer and the audience* in a community. In the context of science education, what could this mean if we are considering school classrooms as communities-of-practice (Calabrese Barton, Lave & Wenger, 1991; Tan & Rivet, 2008; Wenger, 2004)? Driver et al. (2000) proclaim that teachers must “pay attention not only to the ways in which students understand the argument process, but
also to the social skills necessary for conducting arguments in groups” to teach argumentation effectively (Driver et al., 2000, p. 295). Gee states that research into understanding the identities of students is needed in order to teach this science Discourse effectively. In particular, the identities students bring from their personal community, their teacher’s expectations of their identity, the other identities students adopt in various other practices and how these identities intersect – are all necessary in order to teach Discourse (i.e., argumentation) effectively (Gee, 2009). Hence, according to Gee, Driver et al. (2000) and the perspectives of other various scholars mentioned in this section, science educators, curriculum developers, and scholars should acknowledge and appreciate that arguments learned in the classroom rely not only on societal norms, but also on the cultural, anthropological, and historical accounts surrounding a students’ arguments and the process of argumentation (Bricker & Bell, 2008; Driver et al., 2000). It thus follows that educators and researchers must not only conduct future research on how these perspectives affect how students construct arguments and the content of these arguments, but that teachers should also be cognizant of how their own social and cultural perspectives may constrain or help facilitate teaching arguments in the classroom. Commensurable with this, is the call to teach argumentation in a way that allows the science classroom, as a community-of-practice, to establish criteria or standards that reflect the norms of the diverse body of students; this includes students that are historically considered non-dominated.

Bricker and Bell (2008) provide a picture as to what the above research could entail when taking into account children and their unique backgrounds; suggesting that ethnographic studies on argumentation are useful resources that may frame
argumentation into its “sociocultural nature” (p. 485). They present ethnographic instances where “the structural aspects of people’s argumentation, purposes for argumentation in people’s everyday lives, and how context enables and/or constrains argumentation practices” serve to highlight the uses of this type of methodology (p. 485). Interestingly, the authors cite examples where children use argumentation while situated in their daily lives. For instance, one study evaluates Head Start preschool children’s use of oppositional talk, a highly advanced use of language, in which the children argue against another party’s viewpoint, allowing such children to “test or realign the current arrangement of social identifies among peers” (Bricker & Bell, 2008, p. 486).

In their other examples, Bricker and Bell (2008) point out interesting findings from previous studies: claims that girls and boys argue similarly, children’s arguments are filled with important content ranging from stories to threats and warnings; their use of storytelling to explain particular methodologies such as handling conflicts; their views of epistemic authority (e.g., parents, teachers); the need for familiarity in a child’s environment as a way to build more complex linguistic styles; and the use of personal experience as forms of evidence.

In summary, Toulmin’s model has been the primary model used in science education. However, its framework has significant limits beyond assessing how students structure arguments. Researchers who have experienced its shortcomings when evaluating student dialogical argumentation have sought to modify it based on their own research interests. However, despite its use, some scholars argue that Toulmin was an advocate of the importance of context when assessing argument; particularly viewing it from a sociocultural, historical, and anthropological perspective. From this position,
using the Toulmin model along with another methodological approach – such as an ethnographic method, could expose the influences of context more fruitfully in studying argumentation among students.

2.2.2.5 Argumentation and SSIs

SSIs such as stem cell research and global warning are “social issues with conceptual or technological ties to science” (Sadler, 2004, p. 513). Kolsto and Ratcliff (2007) categorize two situations in which students will use argumentation – science topics that are removed from social issues (such as what is used when interpreting scientific experiments) and situations where “science is involved in a social debate” (p. 117).

SSIs are important for two general reasons. One reason is that these issues pervade our societal and political lives, and in ways that citizens of the world cannot ignore (2004). Serious issues such as global warming, genetic engineering (including stem cells and cloning), will not go away in the foreseeable future. Thus, it is up to science educators and research experts to incorporate these issues into the classroom, so that students will be able, as future responsible citizens, to make well-informed personal decisions that will help shape and govern our planet. As Sadler states “…the socioscientific issue movement’s aims focus more specifically on empowering students to handle the science-based issues that shape their current world and those which will determine their future world” (Sadler, 2004, p. 514).

Literature also refers to the need of rationalizing socio-scientific issues as a way to help promote scientific literacy (Driver et al., 2000; Sadler, 2004; Sadler, 2009; Sadler & Zeidler, 2009) with Driver et al. further stressing the importance of argumentation in
improving scientific literacy (2000). Driver et al. state that these topics allow students to reconcile certain SSIs (2000).

### 2.2.2.6 SSIs and informal reasoning

In literature, scientific argumentation may be categorized into two types: formal or informal reasoning (Kolsto & Radcliffe, 2007; Sadler, 2004). In formal reasoning, logic is used, whereas informal reasoning involves both dialectical and rhetorical arguments. Science educator experts feel that formal reasoning is irrelevant in the science classroom, thus many studies focus on informal reasoning, which includes socio-scientific issues, when evaluating student learning (Kolsto & Radcliffe, 2007). Kolsto and Radcliffe further classify informal reasoning as being both an individual activity and one which involves two or more people (2007).

Sadler credits Kuhn for challenging previous concepts of the epistemic standards of scientific knowledge when discussing informal reasoning (2004). Whereas some components of positivism rely on formal reasoning, this movement does not acknowledge the process on how scientific knowledge is acquired, as informal reasoning accomplishes. Sadler defines formal reasoning as static, while informal reasoning “…involves the generation and evaluation of positions in response to complex issues that lack clear-cut solutions. Thinkers are engaged in informal reasoning as they ponder causes and consequences, pros and cons, and positions and alternatives” (2004, p. 514).

Because of the open-endedness and complexity of SSIs, Sadler (2004) argues that these topics are compelling candidates to explore within the realm of informal reasoning. One way for students to process and engage in informal reasoning in lieu of SSIs is to engage them in different practices and skills that will facilitate a final decision (Driver et
These include understanding an argument, including the “implications, assumptions, and inferences” (Driver et al., 2000, p. 306). This also involves understanding scientific knowledge epistemology such as discerning between evidence and theory and learning to reconcile the two concepts. Comprehending the science behind the societal issue including the review of background literature on this topic is necessary, and drawing the distinction between science-related questions and non-science related questions (e.g., related to the economy or law) should be included in curricula. Lastly, students should realize their own morals and values when it comes to understanding these contentious topics; analyzing them when given evidence to assess the validity of a claim (Driver et al., 2000).

2.2.2.7 Group dynamics and SSIs in the science classroom

When evaluating social issues, Kolsto and Radcliffe point out the influence of group dynamics in student evaluation or construction of arguments as mentioned in a previous section (2007). In their example, three boys must determine the type of material to use in building a fictitious window, and provide justification for it (2007). One student, in particular, dominates the opinion of the other two boys, choosing a certain material – PVC – over the other choices. The dominant student does this even though one boy attempts to point out the high cost of the material. Kolsto and Radcliffe use this example to make this suggestion.

Arguments by peers may be accepted more easily or defended more robustly according to group dynamics – the impact of social relationships within a group can have a bearing on the course of the argument. Scientific evidence itself may not sway the position of individuals (2007, p. 123).
Hence, the *social relationships* between peers in a group are an important factor when considering this type of discursive practice (Driver et al., 2000; Kolsto & Ratcliffe, 2007). I will also provide a previously mentioned quote from Gee to help substantiate the term *social relationships* with language and social identities.

…language never operates all by itself. It is always a tool fully integrated with the social and cultural contexts within which it is used, contexts it always simultaneously both reflects and helps to create. Just looking at the features of language and not social, cultural, and institutional factors integrated with language and meaning is not good socio-linguistics (Gee, 2009, p. 4)

That is, an argument as a discursive practice in the science classroom is a form of language not detached from its socio-cultural context. More particularly, the argumentation process – which Driver et al. (2000) suggest involves persuasion, and an exhibition of personal values from the students are embedded in other “social, cultural, and institutional factors” (Gee, 2009, p. 4). The result is fluidity within the argumentation process and its surrounding environment (e.g., the social relationships with peers and teachers). Rose and Calabrese Barton further profess, “Family, relationships, personal experiences, and societal discourses have all been shown to be important factors affecting students’ thinking about socioscientific issues” (2012, p. 2). Understanding, then, that each student brings to his or her group various facets of their lives – their own social identities, that may constrain or enhance their ability to learn argumentation is crucial for the teacher who is teaching this skill. Furthermore, Rose and Calabrese Barton assert that science education research shows very little on how “youth might position themselves in relation to socioscientific issues” (2012, p. 2). Relevant to my research interest, although literature exists that evaluates argumentation among groups of urban youth (Berland & McNeill, 2010; Berland & Reiser, 2011; McNeill et al., 2006, 2011; McNeill & Pimentel,
2010), understanding how they individually “position themselves” in lieu of these types of topics was non-existent at the time of this review. Education literature describing how girls of color situate themselves in socioscientific issues is also limited (Brotman, Mensah & Lesko, 2010; Calabrese Barton, 1998). Unfortunately, it follows that literature evaluating how socioscientific argumentation is situated among girls of color is non-existent.

To further complicate the argumentation process in lieu of SSIs, students will also choose and pick certain pieces of such issues that are relevant to their lives and identities—a process called framing (Rose & Calabrese Barton, 2012). By evaluating the above example from Kolsto and Radcliffe (2007) through this same equity lens, the dominant student may have “attend[ed] to some aspects of the issue, while deemphasizing others” in attempting to justify a claim (2012, p. 2). If we go a bit further and arbitrarily assign this student a societal or cultural position that is historically considered dominant at a macrolevel (e.g., White vs. African-American or upper-middle class vs. lower middle class, boy vs. girl), then the situation becomes an equity issue; as the dynamics of power interact during this group discourse. How is it, then, that all members of this group will have the opportunity to learn the skills of argumentation effectively with these processes bearing in the foreground and background? Presently, there is no scientific education literature that has shed light on this important question.
2.2.2.8 Critical reviews on SSI studies and argumentation

2.2.2.8.1 Sadler & Fowler, 2006.

In describing their own framework on argumentation which focus on socio-scientific issues, Sadler and Fowler (2006), first point out the limitations of Toulmin’s model (Duschl, 2007; Nielsen, 2011; Sampson & Clark, 2008); noting studies in which researchers have resorted to modifying the pattern in order to rid itself of its dubiousness (McNeill, 2011; McNeill & Pimentel, 2009). However, Sadler and Fowler assert that these modifications are only relevant for group studies. Consequently, Sadler and Fowler’s framework focuses on the individual student, arguing that individuals can also take what knowledge they have in one setting and transfer it to other contexts. Their framework is based on previous studies conducted by Sadler and colleagues that suggest that there is a correlation between content knowledge and argumentation skills – the more developed a student’s knowledge is about a particular concept, the higher skilled they are in presenting and defending claims related to the concept (Sadler & Fowler, 2006, p. 989).

In their framework, termed the “Threshold Model of Content Knowledge Transfer” (TMCKT), the author’s state that argumentation and content knowledge are related, but it is a nonlinear relationship (Sadler & Fowler, 2006). The levels of content knowledge range from one to three thresholds. The number “1” signifies the more simple type of understanding, “2” represents “advanced knowledge”, representative of what students who are majoring in that specific discipline express, and “3” represents the knowledge of an expert (Sadler & Fowler, 2006, p. 990). Based on previous studies, the quality of arguments is significantly different at each threshold but not between
thresholds, as seen in a previous study conducted by Sadler and Ziedler (2005b) on high-school students (Sadler & Fowler, 2006). In this particular study, Sadler & Fowler wished to further test their model on a college sample and compare the TMCKT between college and high school students. The authors combined data sets from the previous studies along with the current study, which consisted of 30 upper division undergraduates from a large United States university; 15 were science majors who excelled on a preliminary genetics test, and 15 were non-science majors who had performed quite poorly on the same test. The previous data set included in the study contained 15 students from a high school in the same area as the university. The demographic data shows that males and females were represented equally (Sadler & Fowler, 2006). However, African-Americans were not, with 0%, 27%, 27% included in college science majors, college non-science majors, and among high school students. Also, Sadler and Fowler did not distinguish if any of the African-Americans included females (2006).

Sadler and Fowler evaluated arguments by focusing on the justifications of claims while posing scenarios involving gene therapy for Huntington’s disease and genetic engineering (i.e., creating an intelligence gene) (2006). The authors contended that, “ideally, argumentation in socioscientific contexts would involve justifications grounded in scientific data as well as considerations of the social, economic, and moral implications” (Sadler & Fowler, 2006, p. 993). The justifications were coded from 0 to 4, with 0, meaning that the argument contained no justification and 4, signifying that the justification contained extensive grounds, or supports for the justification as well as recognition of a counter-position. The authors utilized mixed methods to compare the
quality of arguments across high school and college students, and qualitative analysis that evaluated the patterns of justification quality across the different samples of students.

In terms of the patterns of justification, Sadler and Fowler found that among the themes mentioned, religious/social norms were most prevalent (2006). Other themes were the consequences of gene therapy, the use of gene therapy because it was a limited option, trivialization of the issue, and concerns about social equity, particularly with the intelligence gene scenario.

Sadler and Fowler (2006) found that high-school students had more content knowledge than the non-science majors in college but lesser than the science majors. They felt that their TMCKT held true in terms of argumentation quality because the science majors had significantly higher argumentation skills compared to the non-science majors and high-school students, but the latter two did not have any significant changes in their own skills.

Although an interesting study, it is understandable that students who had higher content knowledge would argue their ideas in a more effective manner. However, the authors would have to present more studies to confirm that their threshold model is consistent in interpretation. In addition, it is interesting to see themes surfacing in terms of how students reasoned or supported their claims. However, this study lacks – as does many studies – a more representative body of students. Lastly, though unique as it is to include both high school and college students’ understandings, it is almost certain that college science majors are going to have a higher level of content knowledge than high school students. Accordingly, including a sample of students that attend only high school,
or only college, would have shed more information on the relationship between content knowledge and argumentation skills.

2.2.2.8.2 Sadler and Zeidler, 2005.

Sadler and Zeidler add to existing literature in their focus on genetic engineering issues as SSIs to assess how students resolved such issues (2005). As they state, this is particularly due to reforms in science education which places SSIs in a central role for scientific literacy (McNeill, 2011; McNeill & Pimentel, 2009; NRC, 2011).

Their theoretical framework views resolving SSIs as a form of informal reasoning (Sadler & Zeidler, 2005). As mentioned in a previous section, one characteristic of this type of reasoning involves assessing the pros and cons of particular issues such as SSIs (Sadler & Zeidler, 2005). Because a student must consider these issues that are rift with ethics, informal reasoning involves students relying on their own personal experiences, the complexity of the issues, and considerations based on emotions and social ramifications as well as morals. Hence, the authors wish to explore these factors while presenting SSIs to college students, with the intent of creating a model for informal reasoning.

Though the participants in the study are college-age students and not those in K-12 schools, the findings of this study are extremely relevant for the latter setting, particularly since national standards emphasize the importance of SSIs in promoting scientific literacy in these schools (NRC, 2011). The participants in the study are thirty college students, 15 of which have taken upper division sciences while the other 15 have little experience in this area. Though no intent of their own, there also seems to be an equal distribution in gender. Their methodology is based on qualitative methods (Sadler
All students were provided with six different scenarios related to genetic engineering in two sets of interviews. The authors chose genetic engineering due to the variety of issues associated with this topic and due to the moral nature of such issues. In the first interview, students were asked to state their position regarding the scenarios, their rationale for this position, a possible counter position, and a possible rebuttal for the counter position. Clarification of their positions occurred in the second interview. This clarification involved the interviewer asking questions relative to their personal experiences, social considerations, and moral perspectives. Data analysis was inductive and Sadler and Zeidler sought to ensure trustworthiness by triangulation of data. This involved member checking during the second interviews, audit trails of all raw-data (i.e., audio-tapes and transcripts), and reviewing of twenty percent of the sets of transcripts from both authors. While Sadler assessed for emerging categories after several iterations of the transcripts, Zeidler assessed six sets of these transcripts for arguments and achieved ninety-five percent agreement (2005).

The findings in this study are significant. Sadler and Zeidler found that students used both cognitive or logic as well as emotions in resolving issues (2005). Indeed, students used a combination of rationalistic (i.e., reason and logic), emotive (i.e., empathy and sympathy), and intuitive (i.e., gut-feeling, immediate reactions) when resolving the presented scenarios. In addition, the context of the issue influenced the various reactions of the participants. Indeed emotive and intuitive reasons were the most context dependent.

Sadler and Zeidler concluded that in resolving SSIs, one cannot isolate the moral, personal, or social factors from students (2005). Although rationalistic reasoning is
significant, understanding that affective reasoning (emotion-related factors) is also important, or teachers may run the risk of excluding other students, an assertion shared outside the field of science education (Gilbert, 1994). Ultimately, the authors contend, personally engaging all students relies on integrating all modes of reasoning (Sadler & Zeidler, 2005).

2.2.2.8.3 Venville and Dawson, 2009.

Although, Venville and Dawson share similar sentiments to Sadler and Zeidler (2005) concerning the role of SSIs in informal reasoning and in the construction of scientific knowledge, the latter pair of scholars bear some differences from the previous study (Venville & Dawson, 2009). Commensurable with Sadler and Zeidler are the use of genetic-engineering SSIs in their study due to the variability of such scenarios. Venville and Dawson also argue for the necessity of the logical or rational patterns of reasoning. Venville and Dawson’s objectives are different, however, and focus on the role of argumentation as aiding in conceptual understanding (2009). The authors sought to investigate the written argument structure of students, using Toulmin’s model, its role in informal reasoning, and possible conceptual understanding of genetics using argumentation of SSIs.

Venville and Dawson conducted their research in a large suburban Catholic high school in Australia, where the student population consisted of a homogenous group of 10th grade students (2009). The authors imparted an embedded case study. The 46 students were divided so that one group of students (two classes) was taught explicit argumentation and the latter group was not. Those that were taught argumentation learned this skill in three lessons. However, all classes received background instruction
on genetics. Venville and Dawson spent two hours of instructing the teacher on how to teach this practice to the selected students.

In assessing argument structure, Venville and Dawson assessed the ability of students to use various components of Toulmin’s model (i.e., claim, data/warrant, backing, etc.) and Sadler and Zeidler’s modes of reasoning (2009). They found that students who were taught argumentation were more likely to frame their argument correctly compared to those that were not (p=0.003 and p=0.0001). They also found that those taught argumentation were more likely to use rationalistic reasoning versus intuitive and emotive (p =0.041 and p=0.002). Assessing for conceptual understanding of these topics, it increased for both groups (both argumentation and non-argumentation), but slightly more for the argumentation group, over the course of ten weeks (p<0.001).

Venville and Dawson (2009) concluded that explicit argumentation increased the complexity of argument structure, rational mode of informal reasoning was more prevalent with this instruction, and that conceptual understanding seemed to only modestly increase for those taught argumentation.

2.2.2.8.4 Other SSI argumentation studies- need for diverse student populations.

To segue into argumentation studies that focus on underrepresented groups, I will discuss relevant portions from other studies that are found in literature which highlight the need for a look into marginalized students and how they engage in scientific argumentation. This is apparent where studies of argumentation and SSIs occur in different countries, carrying its own difficulties (Sadler, 2004; Venville & Dawson, 2009; Zohar & Nemet, 2002). For instance, in Venville and Dawson’s work (2009), these authors affirm that their population is relatively homogenous. My research interests are in
diversity, particularly marginalized populations; hence, such a statement warrants an explanation as to why – given the diversity of the global student population, this is a good thing (NRC, 2011). Venville and Dawson go further to assure their audience that they selected only the most qualified teachers in their article (2009). However, there are school districts in our own country that do not have the proper equitable resources found in more affluent areas, including well-qualified teachers or professional development programs, that could help create and maintain the novel curricula required for diverse populations (Berland, 2011; Berland & Reiser, 2011; Settlage & Meadows, 2002). Hence, Venville and Dawson are looking through a different lens; one that is grounded in observing conceptual understanding improvements, but not grasping that these improvements must be broadened to include students from various socioeconomic, cultural, and racial backgrounds.

On the contrary, Sadler and Zeidler (2009) suggests thorough instruction on SSIs and argumentation requires more than presenting local issues to children; but involving a consideration of the backgrounds and identities of the students (Sadler, 2004). In his paper, Sadler (2004) suggests that future curricula and pedagogical methods would benefit from explicit argumentation instruction that relates to students’ personal interests. In this sense, the personal connections will undoubtedly involve various societal, cultural, and political implications for each student (Rose & Calabrese Barton, 2012). As a way to perhaps reconcile this issue, Sadler and Ziedler (2009) build on the work of Gee to call forth a socio-scientific Discourse. The authors state,

[Socio-scientific Discourse] construct to represent understandings and practices in which individuals engage in as they thoughtfully negotiate and work to resolve SSIs; stating that such knowledge concerning this Discourse is essential in
eventually providing scientific literacy for all, including the “development of identities that support enactment of these Discourses” (2009, p. 913).

The authors assert that the actual components of this discourse are left to question, since such discourse is contextually variable and will also change with each distinctive SSI (2009).

In their article, Sadler and Ziedler define what socio-scientific Discourse.

[It] balancing the social complexities of SSI including economic, ethical, and political effects of various courses of action; employing scientific habits of mind such as skepticism; and engaging in argumentation in which ideas, data, and principles are examined, tested, and refuted (2009, p. 913).

Such a definition provides a more workable space in which to consider students negotiating SSIs in lieu of their social identities. However, in their papers that describe this type of discourse, which includes argumentation, Sadler (2009) and Sadler and Ziedler (2009) do not specify the ways and processes students may negotiate such “social complexities” (Sadler & Ziedler, 2009, p. 913). Rose and Calabrese Barton (2012) shed some light, as mentioned above, by positioning students’ backgrounds at the center of SSIs in their study, arguing that student thinking includes taking into account “family, relationships, personal experiences, and societal discourses” (p. 2). Evaluating both papers with Rose and Calabrese Barton’s proclamation as an underlying assumption causes me to wonder how African-American girls of color specifically negotiate these SSIs successfully, all in the frame of argumentation, when taking into account their thoughts and views on family and personal experiences. I also question what sort of societal discourses these girls may take into account given that their discourses will vary greatly depending on the environment(s) that they reside in – both in school, in the
science classroom, and outside of school. These points will be discussed further in the latter part of this review.

2.2.2.9 Critical reviews on argumentation and marginalized groups

2.2.2.9.1 McNeill (2011).

In a study by McNeill (2011), the author researched a group of fifth grade students in a large urban district. The school population consisted of 60% African-American and 12% Latino/a with classrooms expressing similar diverse characteristics. The classrooms also had 18 females and 15 males (2011). McNeill describes the school as being poverty-stricken – with 82% of students qualified for a reduced or free lunch. By utilizing data sources such as pre-and post-student interviews, videotapes of classroom instruction, and student writings, she found that marked improvement occurred in the ways fifth grade urban children viewed argumentation and evidence from the beginning of the year to the end of the school year. McNeill states that students developed “a stronger understanding of the norms in their science classrooms” (McNeill, 2011, p. 817). However, there was a distinct separation of ideas found when comparing views on argumentation, explanation, and evidence in an everyday context to what occurred in the classroom and in the lives of professional scientists – occurrences that remained consistent throughout the whole year. McNeill herself says that because of this “it may have helped students to talk about how their views in their everyday lives differed from expectations in science class” (2011, p. 817), including more research that “follows students into settings outside of the school into their many everyday contexts” (p. 818). In this way, McNeill seems to hint at the need for an ethnographic study that looks into
these students lives (Anderson, 1989). Borrowing from other literary scholars, McNeill implies that a thorough look into the students’ “home, community, and peer networks” (Moje et al., 2004, p. 41) may be beneficial to indoctrinate such students into argumentation, a form of Discourse considered “privileged or dominant in social interaction” in the science classroom (Moje et al., 2004, p. 41).

2.2.2.9.2 McNeill and Pimentel (2010).

In another pivotal study, McNeill and Pimentel strive to study the structural argument and dialogical interactions of three urban classrooms. They define dialogical interactions between peers and between peers and teachers as “persuasion or the interactions that occur between individuals when they try to persuade or convince an audience about the validity of their knowledge claims” (2010, p. 206). Because of the numerous ways of defining argument, McNeill and Pimentel (2010) helpfully define their own meaning to contain both a structural and dialogical component. The structural component, as with a large majority of argumentation studies, uses a modified Toulmin’s framework to assess students’ ability to justify a claim. McNeill and Pimentel point out the importance of constructing and evaluating claims to the practice of science and center their study on this premise (2010, p. 205).

In their background, McNeill and Pimentel outline the support that teachers must provide in peer interactions involving argumentation (2010). Teachers should seek to guide their students more as well as serve to model how to critique claims and their reasoning, or justification. Because of diverse student learning styles, teachers should also utilize various instructional methods to teach argumentation.
The authors use their self-designed UrbanEcolab – “for the 70% of students who live in urban areas, urban ecology provides local problems, resources, and opportunities for teaching and learning.” (2010, p. 207). The unit and study were created for 11th and 12th grade students, in the hopes of engaging them with a curriculum within a local context. McNeill and her colleagues design this unit to promote explicit argumentation and “interactive classroom discourse in which the students played an active role” (McNeil & Pimentel, 2010, p. 207). In their study, the focus is specifically on global climate change. The teachers present students with two video clips that offer different viewpoints on climate change. McNeill and Pimentel point out that the clips were not high in scientific content but were chosen to provide latitude for students in reflecting their own ideas and justifications for their claims. Students were then to write an argument on whether climate change is actually occurring and to provide evidence to support their claim. After this written assignment, a teacher-led discussion occurred based on the written arguments.

McNeill and Pimentel evaluate three classrooms which contained 46.7% to 61.7% Blacks in the classrooms. Hispanics made up 32.6 to 33.9% of the classroom populations (2010). All classrooms were taught by three different teachers. McNeill & Pimentel also mention the low graduation rate of students in this school (2010).

The authors analyzed all classroom discussions by counting utterances, or the amount of ideas mentioned by students and teachers. These utterances were evaluated to determine if the teacher dominated classroom discussion and such utterances were also categorized using different coding schemes relevant to the structure of the argument, dialogic interactions and questions asked by the teacher (McNeill & Pimentel, 2010).
instance, in terms of argument structure, an utterance could be coded as a claim, or a claim along with evidence, or a claim, with evidence, and reasoning (explanation on the use of evidence). The authors divided the evidence into types: scientific, personal, or other. Personal evidence was defined as “information from students’ everyday lives, such as comments about weather patterns during their lifetime” (McNeil & Pimentel, 2010, p. 211). Dialogic interactions were categorized as being independent or containing an idea or statement not associated with a previous belief. They were also viewed as connected, dismissal; where an idea was clearly or implicitly shown to not be necessary for the discussion. Interactions also involved acknowledgement of the idea.

McNeill and Pimentel found that the range of utterances differed for each classroom, with one classroom discussion being led mostly by students and the other two classrooms representing more of a normative science classroom with the teacher leading discussions (2010). The authors found that different types of evidence were used in all three classrooms which relied on how each teacher led the course. For instance, scientific evidence dominated one classroom in which the teacher constantly redirected students to what was in the video. However, in the other two classrooms students were more likely to use personal evidence. McNeill and Pimentel also found that connections between previous ideas in the discussion differed across classrooms; this in turn was related to how the teachers chose to handle a student’s utterance. For instance, one teacher attempted to take another young boy’s statement about the sun being too old and connect it with the rest of the discussion. The authors also found that the degree of open-ended questions asked by the teachers differed across classrooms ranging from 22% to 71%. Overall, McNeill and Pimentel found that classrooms dominated by student talk and
where the teacher asked more open-ended questions used varied forms of evidence and the students were more likely to discuss and debate ideas with their peers (2010).

In their conclusion, McNeill and Pimentel argue that to engage students in science classroom discourse, connecting their personal experiences with classroom discourse is necessary (2010). The authors state,

Students constantly engage in border crossing in which they need to navigate different cultures in the context of school, family, peers, and work with often very little assistance in navigating these transitions. Teachers should make clear that different types of knowledges and experiences are welcome in the science classroom to actively construct a third space that helps students navigate different discourses (McNeill & Pimentel, 2010, p.225)

McNeill and Pimentel give an example of one student, Rasheed who provides his first piece of evidence to support his claim but because it is personal, the teacher, Mr. Dodson, dismisses it. In this situation, McNeill and Pimentel clarify the need for teachers to welcome such personal experiences of children into the classroom as a way to aid in culture crossing (2010).

In another portion of the paper pointedly referring to the classroom dynamics, McNeill and Pimentel provide a sample of a classroom transcript from the student-driven classroom discussion. In this piece, a student asks the teacher, “Can the sun get ready, get ready to explode?” (2010, p. 218) The teacher then poses the same question to the rest of the class. Alesha, a female student answers “No, it’s the atmosphere, the atmosphere is over…” and the rest of her explanation is inaudible (p. 218). After this, a male student, Jamar states “maybe the sun is too old”. In this instance, I wonder if Alesha’s explanation is complete or if Jamar interrupted with his line of reasoning. Later on, another student, Maria offers her own reasoning after Jamar proposes another explanation. After this, Alesha agrees with Maria, adding her own line of reasoning. In this example, how did
Alesha feel during this exchange? Although McNeill and Pimentel label the structure of her utterance as an “other” the first time she speaks, perhaps due to the inaudible nature, was Alesha on the verge of providing solid reasoning for her claim but it was interrupted by Jamar? What were the actual dynamics going on in the classroom at this moment between Alesha and Jamar? Did Alesha feel more comfortable expressing herself after another female student, Maria, provided her own reasoning? How could the teacher have ensured that Alesha’s voice was heard initially? In the small piece of transcript, it shows that Ms. Baker responded only to Jamar in this sense – and not to Alesha. Hence, in this example – when I put on a critical and feminist lens – the possible interplay of power dynamics is brought to light between peers and between peer and teacher.

2.2.2.9.3 Berland and McNeill (2010).

Berland and McNeill describe and analyze four different examples – spanning from elementary to high school science classrooms – in an attempt to assess how student progress develops in scientific argumentation. The authors compare this progression using three areas: “instructional context, argumentative product, and argumentative process” (2010, p. 765). The authors in particular wish to focus on engaging students in argumentation while at the same time facilitating comprehension of the scientific knowledge and the practices of science.

Although learning progressions can be defined in different ways, according to Berland and McNeill, the predominant issue is that such progressions presuppose developmental abilities (2010). Berland and McNeill support studies that suggest students already have naïve abilities to argue; hence, instruction on strengthening these abilities should take precedence over any cognitive abilities.
Berland and McNeill (2010) define their three areas of progression from simple to complex. In an instructional context, the focus is on ensuring students are engaged. In a *simple* instructional context, the questions are explicitly stated and clarified with two to three possible answers, the data is small and it contains only relevant data to the topic. However, in a *complex* context, the questions become open-ended, with students possibly defining their own data, and the data contains both relevant and irrelevant information.

In a *simple* argumentative product, students provide claims that answer the specific question. They can also defend their claims, however counterclaims are not refuted. Additionally, claims may contain “evidence, reasoning, and rebuttal” (Berland & McNeill, 2010, p. 770). However for a *complex* product in argumentation, the claims can be defended with both evidence and reasoning, it answers a question more descriptively with a causal relationship (2010), counterclaims are refuted, and the components of the claim are sufficient to the question asked.

Lastly, the *argumentative process* can be determined as *simple* when the claims are “articulated, defended, questioned or evaluated” and students participate only after being prompted by the teacher. However, the *complexity* of this process results when students and teachers both work together to prompt an argument, and even more so when students need no prompting in engaging in argumentation.

Berland and McNeill (2010) found that when comparing these domains from elementary to high school, 7th graders – who had a relatively simple instructional context at the end of the year – engaged in what seemed to be the highest levels of learning progression. However, the authors do admit that in the beginning of the year, the instructional context was relatively complex, resulting in a simple engagement. They
conclude from this that the instructional context may play a significant role in the ways children construct arguments.

Berland and McNeill also explain the need to explicitly outline the norms of scientific argumentation – as first proposed by Driver et al. (2000) – to help facilitate the process of argumentation. The authors propose an example of this by suggesting teachers unequivocally delineate any student “predictions, hypotheses, inferences, and conclusions” as requiring evidence and reasoning (Berland & McNeill, 2010, p. 788). The authors assert that this practice will place the focus away from the student and their ideas, to the actual supports used, resulting in students assessing whether claims are coherent and valid based on scientific evidence (Berland & McNeill, 2010).

One contention that I have with this suggestion, is the implication that a student is separate from her own ideas and ways of formulating supports; constitutive of some tenets of the hardline positivistic movement (Atwater, 1998; Longino, 1990). Proponents of this philosophy believe in a disembodied form of knowledge; apart from the knower, or the person seeking such knowledge. The emphasis is thus placed on the knowledge being found rather than the process of how it is acquired. The latter requires insight into the knower. From my perspective, the argumentative product Berland and McNeill speak of is analogous to the product at the end of a scientific discovery, concepts that appear static and unchanging when viewing curriculum materials in the science classroom. If this is the case, this argument contradicts previous studies on the importance of acknowledging a student’s personal experiences when teaching argumentation (McNeill, 2011; McNeill & Pimentel, 2010).
In a study by Berland and Reiser (2011), the authors highlight the need for a more critical examination of argumentation in marginalized groups (2011). In this article, the authors studied the argumentation styles of two different urban schools. The authors chose these two classrooms based on their ability to complete a curriculum unit self-designed to “support student participation in scientific practices (such as argumentation) as they engage in project-based investigations” (Berland & Reiser, 2011, p. 195). This seemed to result in two classes with strikingly different ways of adapting to the norms of their classroom, despite the homogeneity in their racial makeup. In this sense, Berland and Resier’s study is a wonderful example of the need to apply a probing lens into the various discourse styles of students in urban populations (2011).

The classrooms were two 6th and 7th grade classrooms. The 6th grade classroom was located in a charter school where 94% of the students were African-American. In a follow-up study to be discussed following this one, Berland (2011) includes the race of one of the teachers, a young African-American male in his 20s; Mr. S. Berland and Reiser state that the school was located in a high poverty-stricken area where 89% of students were enrolled in a free or reduced school lunch program (2011). The authors highlight the inequity found in urban school districts (Elmesky & Tobin, 2005; Settlage & Meadows, 2002), by stating that the units were not completed in this classroom due to “inexperience with science instruction and difficulties acquiring equipment” (Berland & Reiser, 2011, p. 196). The 7th grade classroom was located in a magnet school where 95% of students were African-American and 62% were enrolled in a free or reduced school lunch program located in an affluent African-American neighborhood. Students had to
pass math and reading examinations to gain entry into this school. This middle school
class was also headed by a White female teacher, Mrs. B.

Berland and Reiser use a theoretical framework grounded in student sense-making
and persuasion to evaluate how students create and defend claims, question and critique
other students’ claims, and revise their claims. The goal of this study was to study how
different middle school science classrooms adapted to the process of scientific
argumentation. In a separate paper that explored the two classrooms in further detail,
particularly their variations in classroom practices, Berland relies on a model premised on
the communities-of-practice model from Lave and Wenger (2011). This will also be
discussed in a subsequent section.

The authors provide extensive detail into the meanings of sense-making and
persuasion. In the former, practices such as the construction, questioning, and defense of
claims takes place. In persuasion, the emphasis is also on defending one own claims as
well as evaluating and critiquing other claims (Berland & Reiser, 2011). Attending to
others falls under both sense-making and persuasion. The authors coded and analyzed
classroom transcripts based on coding schemes that focused on how knowledge was
constructed, the types of utterances spoken (e.g., claim or question), the persons involved
in the interaction (e.g., student to student, student to teacher), and the presence of
resolution of an argument.

Berland and Reiser describe the differing characteristics of these classrooms
(2011). For instance, in Mr. S.’s class, the process of learning argumentation was not as
“structured” as Ms. B’s class as evident during a debate in Mr. S.’s class (Berland &
Reiser, 2011, p. 202). In this instance, the authors describe a “heated exchange” (Berland
that occurred among students for 36 minutes involving a disagreement over a simulated ecosystem program. However, in Ms. B’s class, the students were assigned roles by the teacher and “students only spoke when it was their responsibility – or role – to do so (i.e., to present an argument or question an argument)” (Berland & Reiser, 2011, p. 203).

The authors found that in both classes, the percentage of students sharing their ideas was equal – 65%, meaning students interacted with each in both classes more so than with the teacher. Berland and Reiser do note a striking difference in how students responded to each other’s claims across classrooms, however (2011). In Mr. S.’s class, students were more apt to critique each other’s claims, whereas in Ms. B.’s class, the students “did not indicate whether they agreed with one another’s arguments, instead they asked questions that elicited more information about the arguments.” (Berland & Reiser, 2010, p. 206).

The authors conclude that “classrooms might vary in what elements of the practice they emphasize, and engage in different coherent “slices of the practice”” (Berland & Reiser, 2011, p. 209). Put succinctly, classrooms will have varying patterns of sense-making and persuasion that will affect learning. For instance, Mr. S’s class focused more on persuading and defending their claims while Ms. B’s class concentrated more on making sense or seeking information about the claim, according to Berland and Reiser’s model (2011). Students in Ms. B’s class resorted to asking questions instead of refuting claims. Because the authors’ goal is to explore the variety of ways classrooms adopt argumentation discourse, they state, “In other work…we examine the source of the
variation (i.e., did the teachers set up the class discussions differently? Do the students have different backgrounds?)” (Berland & Reiser, 2011, p. 210).

The need to write a separate paper on the identities of the students from these classrooms highlights a significant problem in the presentation of argumentation literature to date – that analysis of the backgrounds of marginalized students are thought of as detached from how they, construct, evaluate, or critique one another’s claims. How would a critical lens look in this instance? One example could involve exploring the roles of the African-American male and White female teachers in this study (Berland & Reiser, 2011). A question posed may look similar to this: to what extent did Mr. S’s race and gender play in making the students feel relaxed enough to yell out their disagreements in class? For instance, a student talks to Mr. B. in a way that implies their teacher is very relatable to his students. Further, Atwater, Freeman, Butler, and Draper-Morris (2010) note the importance of understanding backgrounds of both the teacher and the student in this statement,

When teachers and students had similar backgrounds, teachers were more likely to understand their students. If there was not a foundation for the teachers and their students to share, then tensions and barriers in communication grew and beliefs about the —Others were incorporated into the school culture and passed along to new teachers (2010, p. 288).

Specifically, teachers who have an ideologically dominant culture compared to their marginalized students may face tensions that are detrimental to the underrepresented student; affecting the way they view the lives of these students outside the science classroom, especially if there are distinct socio-economic differences (Atwater et al., 2010). Using this as an underlying premise, it may be possible that the students in Mr. S’s class felt more comfortable due to their similar racial backgrounds (Atwater, 2010).
Atwater further states,

The dominant ideologies embody power and influence educational policies and practices in the United States. Both the content of education, including science education, and its systems play an important part in regulating and defining students in comparison to a perceived norm (emphasis placed by me). Of course, the norm is established by the dominant group (2010, p. 288).

In this case, the predominantly African-American class headed by Mrs. B’s class may have felt uncomfortable critiquing one another’s claims in the company of their White female teacher. While Berland and Reiser note the quiet behavior of the students in Ms. B’s class – following her rules and guidelines – it could also be the case that the students were reluctantly following “the same prescribed, unquestioned, and sometimes oppressive science content that do not assist them in changing their worlds around them” (Atwater, 2010, p. 289). Indeed, even Berland and Reiser observed Ms. B’s class’s lack of engagement compared to the students in Mr. S’s class (2011). This was confirmed in Berland’s (2011) follow-up paper in which she states,

The sense that Ms. B’s students had less enthusiasm than Mr. S’s students was most apparent in the student-to-student interactions...students in Ms. B’s class engaged in an orderly discussion in which they met the responsibilities of their various roles: Presenters offered their arguments; questioners asked questions that the presenters answered, and observers silently watched and listened (p. 650).

Additionally, Berland and Reiser (2011) compare their results to a study conducted in another country. However, comparing classrooms in which the cultures are strikingly different is not effective; especially when attempting to unravel the local production of knowledge and engagement of these students. For instance, Mr. S’s students may have been developing their own ways of sense-making when critiquing each other’s claims during their heated exchange (Berland & Reiser, 2011). Again, a probing look into the lives of these students is necessary to further explore this
implication. In a study by Hudicourt-Barnes (2003), for instance, the argumentation style of the Haitian Creole students during a debate involved interjections with laughter and yelling. However, this scaffolded learning of a particular scientific concept.

Another point of contention is the homogenous grouping of urban boys and girls found prevalent in science education literature (Berland, 2011; Berland & Reiser, 2011; Brown, 2006; Emdin, 2010; McNeill, 2011; McNeill & Pimentel, 2010). Neither in Berland and Reiser’s study (2011) or in Berland’s (2011) follow-up paper was gender noted as a significant factor in the argumentation process. Such groupings do not even attempt to proclaim implicitly that “boys will be boys and girls will be girls” as Brotman and Moore mention, but dismiss them as an all encompassing entity with similar identities (2008).

2.2.2.9.5 Berland (2011).

In Berland’s follow-up paper, she expounds on her goal to investigate how scientific practices must stay align with classroom practices, particularly in the area of scientific argumentation. As stated previously, she relies on Lave and Wenger’s community of practice model to describe classroom and scientific activities in her study (2011). She focuses primarily on the last three tenets of a practice model that is proposed by Lemke as well. These are the constraining of student behaviors with each practice, the goal-oriented role of these practices and their ability to change.

Her emphasis on the “vast differences in each class’s argumentation” is a significant point of analysis (2011, p. 627). As described above, Mr. S’s class focused more on debating and competing with each other’s ideas whereas Mrs. B’s class focused on actually learning one another’s ideas.
In her paper, Berland contends that there is a certain disconnect between the practices in a science classroom and scientific argumentation, particularly because traditional practice involves the IRE approach, whereas scientific argumentation includes collaboration and persuasion, all in the hopes of understanding certain phenomena.

Berland (2011) uses a design-based research study in conjunction with her previous study with Reiser (Berland & Reiser, 2011) where she worked with researchers to design and create a curriculum as described in the previous study. The curriculum was a Grades 6-8 science curriculum called “Investigating and Questioning our World through Science and Technology”. Berland evaluated four biology classes and relied on video-taped class sessions, pre-and post student interviews and teacher interviews. Berland also analyzed transcripts of both Mr. S and Ms. B’s classes. The primary goal of this study, according to Berland was to “identity ways in which existing classroom practices influence a classroom’s adaptation of the practice of scientific argumentation (Berland, 2011, p. 633).

In order to evaluate the distinction first between normative classroom practice and that involved in argumentation, Berland investigated both situations separately. She did this by analyzing two 3-minute segments from a non-argumentative context. She found that during these intervals there were about 25 different contributions from participants.

Berland developed a straightforward approach to code that focused on the justification of claims, rebuttal to arguments, and responding to “oppositional episodes” (Berland, 2011, p. 635). Her design included a second coder to validate the coding schemes.
Berland thoughtfully lays out her analysis to inform the reader on “why students in each class engaged in scientific argumentation in the ways in which they did” (2011, p. 637). Her findings confirm similar results in a previous study (Berland & Reiser, 2011), that students were engaged and eager to partake in the activities of the class. Berland demonstrates that while these students were willing to volunteer responses, most of their non-argumentative discourse was not justified (61%). Also resolution of claims usually required the help of Mr. S.

In regards to teaching argumentation, Berland (2011) noted the lack of Mr. S.’s thorough knowledge in teaching this practice, his lack in the proper classrooms tools as proper teaching resources, and his inability to fully communicate the classroom goals in argumentation.

In regards to the students, Berland (2011) noted the increased student-to-student responses in argumentation versus non-argumentation and that these were often “heated exchanges” (Berland, 2011, p. 643). However 65% of students were able to justify their claims.

Berland (2011) compares Ms. B’s class in terms of the oppositional episodes related to Mr. S’s class. She finds that the students in her class seemed to challenge her in 42% of these cases, but finally accepted her statements without further debate while Mr. S.’s class consistently debated issues. This is an expansion of the previous study by Berland and Reiser who noted the lack of engagement in Ms. B’s class compared to Mr. S.’s class (2011).

However, Berland also notes other differences not previously described (2011; Berland & Reiser, 2011). Ms. B’s class also differed than Mr. S’s in that the former
assigned roles dutifully to the student. Each individual student then seemed to have an idea as to how to conduct their interactions. Ms. B. also had explicit roles for students who wished to challenge another student’s debate. This was done by using a “Question Board”. This also allowed Ms. B. little interaction with the students as they were familiar with their roles and no longer needed her guidance with this tool. The instructional resources of Ms. B. then differed drastically to Mr. S.

As stated above, Berland notes on the differences of student engagement in both Ms. B’s and Mr. S’s classes. However she did find that both classrooms consistently shared similar goals in their structure of argumentative and non-argumentative discourse. Most importantly, Berland found that Ms. B’s classroom seemed to have less difficulty in understanding argumentative discourse based on their previous classroom practices which were similar. However, Mr. S’s introduction into argumentation was remarkably different than his non-argumentative instruction, leaving ample room for the students to resolve their own interactions and resort to their own rules. Because this study is an extension of Berland and Reiser’s study previously described (2011), I have already integrated parts of Berland’s study into the former to allow for a richer picture of what the story entails. However, in Berland’s study, it is not hard to miss the disparity of teaching and instructional resources provided to Mr. S., the African-American teacher in a poverty-stricken neighborhood compared to Ms. B., who taught African-American students in an affluent neighborhood. The question not only becomes a curricular-based one, but an instructional one as well. Teachers in urban communities often lack the proper resources to teach marginalized students effectively, even when such students show enthusiasm to learn such materials (NRC, 2011).
Applying a theoretical framework that evaluates gender to both preceding studies would add a great deal more information to these studies and to the area of science education as a whole (Berland, 2011; Berland & Reiser, 2011). For instance, posing questions such as: Did any particular gender predominate in one class? What role did the different gender dynamics play in evaluating and critiquing each other’s claims? Instead of exploring this area, however, Berland (2011) states that her analysis focused on “broad patterns at the expense of exploring variations in individuals’ behaviors”, explaining that this practice “makes sense in the environment of a classroom in which teachers and curricula guide the practices in which students engage” (Berland, 2011, p. 652). I have a difficult time understanding how this could “make sense”, particularly when Berland herself says shortly after, “future research should examine more closely the ways in which individual variation results in classroom communities adopting and evolving the argumentative practice over time” (p. 652). Studying this individual variation would require using a feminist and critical framework to flesh out the particular subtleties of the cognitive processes and engagement of African-American girls, for example, to understand the evolution of adopting a new classroom practice.

2.2.2.9.6 Emdin (2010) - Learning urban discourse precedes argumentation.

Another in-depth look into Emdin’s study on urban youth is required (2010). Emdin’s research is particularly unique in that he explicitly states his personal experiences as a student as well as a teacher and professor of urban education shapes the motivation behind his research. This study is also significant because he probes further into the discursive practices of the youth than the previously mentioned studies. However, he also has a particular stance on teaching argumentation to urban youth that
differs from McNeill and her colleagues (Berland & Reiser, 2011; Berland & McNeill, 2010, McNeill, 2011; McNeill & Pimentel, 2010). Still, his work highlights important areas that the science education community as a whole needs to take heed of when teaching argumentation and discourse to all students, especially African-American youth.

In the beginning of Emdin’s article, he discusses the current problem in urban science classrooms, “Rote practices become valued in urban science classrooms, whereas activities and processes that indicate true engagement in science such as questioning, sharing one’s thoughts about a concept, argumentation, and debate are rarely supported, and therefore, rarely occur” (Emdin, 2010, p. 2).

In this statement, Emdin (2010) highlights one significant problem in urban areas; the lack of equitable resources in these populations to fundamentally and effectively teach the skill of argumentation – underlining the dire need for professional development courses and more qualified teachers (Dance, 2009; Elmesky & Tobin, 2005; Settlage & Meadows, 2002)/

Emdin further describes the need for educators to adhere to national standards promoting the need for discourse and debate, issues that are still new in suburban districts, “but that are generally understated, or not implemented in urban schools” (Emdin, 2010, p. 2). However, Emdin also contends that “before scientific argumentation can be supported in urban schools with large populations of Black and Latino/a students, an understanding of the distinct modes of communication of these populations must be in place” (2010, p. 3).

Emdin goes on to assert – based on his own experiences as an urban student in science and through present research – that teachers in urban classrooms misunderstand
the communication of urban youth and their willingness to engage in learning that may be markedly different than students in suburban populations (2010). Such misinterpretation on the part of teachers may cause them to create strict guidelines in the classroom, where the teacher remains the staunch authority figure, and students are fed a prescribed curriculum of rote practices (2010; Atwater et al., 2010).

In his 4-year ethnographic study, he creates a theoretical framework that utilizes the rap cypher found in urban hip-hop culture, based on his observations and analysis of peer-to-peer, and teacher-to-peer interactions (Emdin, 2010). Emdin proclaims that understanding this form of discourse – which occurs outside the classroom and in which he describes as having its own nuanced African-American verbal and non-verbal discourse – would be beneficial in understanding and facilitating student engagement in an urban classroom. He outlines levels of transactions apparent in these urban classrooms (Emdin, 2010). Emdin defines transactions as “occur[ing] between two people or among larger groups for the purpose of sharing some type of capital and gaining the same” (2010, p. 6). Such transactions include behavioral styles that support other students through cheers or completing other’s sentences. Emdin’s table of transactions is divided according to his students’ use of gestures, their voice volume, their engagement into science with discussions, and peer interactions (2010).

In his study, Emdin utilized observation and field notes on one class of 28 students for the entire year, and subsequently assigned five students as student-researchers. These students documented verbal and non-verbal behaviors outside of class such as the playground and school lunchroom. He performed data analysis of video and field notes with the students – analyzing approximately 5000 video clips of students for
this study. The students perused the clips with Emdin, looking for communication instances and coding these vignettes based on the levels of transactions.

Based on his results, Emdin found that urban classrooms are generally level 2 in their transactions, with some students reaching levels of 3 and 4 – improved student engagement and student learning (2010). He proceeds to characterize the level 3 and 4 students as ones who explain concepts to peers, sit quietly in a circle, etc. Emdin states that teachers should try to facilitate a classroom style that promotes the same characteristics found in a rap cypher, where students feel as if they are being heard rather than the normative classroom where students, in his study remark,

I don’t care what she (the teacher) has to say, we’re just doing our thing and she can do hers…We just do what they (teachers) tell us (students) because that is what they want us to do… and It’s like science class is meant to be where everybody has to be quiet and do the same thing (2010, p. 14).

One assumption that I make about this paper, is that Emdin published it in response to both national education standards promoting the use of argumentation for scientific literacy as well as emerging studies on argumentation that focused on urban populations (Berland, 2011; Berland & Reiser, 2011, Berland & McNeill, 2010; McNeill, 2011, McNeill & Pimentel, 2010). Emdin provides a thoughtful analysis on the lives of urban youth, and without mentioning such terms, probes into the social identities and discourses of students, outside and inside the classroom (2010). Such deep and thoughtful analysis is reminiscent of Brown’s work on urban youth and his formulation of what is called the discursive identity: a phrase he creates to describe how African-Americans negotiate their science identity formation with their forming social and cultural identities (Brown, 2004, 2006). Though Emdin attempts to set himself apart from Brown (2006), by stating that the former focuses more on linguistic differences and not the overall discourse of.
students - including their social backgrounds, both types of research are necessary when considering argumentation for marginalized groups (Brown, 2004, 2006; Brown et al., 2005; Emdin, 2010).

However, I am concerned about one of his assertions; that argumentation in the classroom cannot be taught without understanding the communication styles of urban youth. I must first state that I agree partly with his sentiment – that a thorough understanding of the backgrounds of the youth in his study would benefit greatly the ways in which teachers can promote argumentation in such classrooms. Emdin begins to focus on probing deeper into the background of marginalized groups. However, implementing such a skill in the urban classroom may still be achieved while at the same time using a critical lens to help propagate the studies of argumentation and marginalized groups. At times like these, it is good to just jump into such practices and report on the findings. In this way, a deeper analysis into marginalized groups – such as the girls of color – can at least begin while these students are learning the complex process of argumentation. Such field studies would be fruitful as long as research attends to both the critical and feminist elements.

Second, as a feminist thinker, I am also concerned about the different ways each student may situate argumentation in the classroom, particularly African-American girls, and not just the unitary “urban youth” in the class. More important to my research interest are these questions: did the rap cypher that Emdin argues would be helpful for teachers also provide a communal atmosphere for the African-American girls based on their own perspectives? In a hip-hop culture that is highly dominated by male rappers in the media, in which women are predominantly portrayed as the infamous “Black Jezebel” in music
videos, were these stereotypes themselves manifested in the classroom, on the playground, or in the cafeteria (Hill Collins, 2004)? The Jezebel caricature maintains that Black girls or women dress in highly provocative fashions, silently dancing or swaying seductively in the background while male rappers dominate the song. Dill and Zambrana suggest a way to reconcile this problem in the hip-hop culture through the use of an identity framework on intersectionality (2009). Using this framework comprises more than a look into race as a way to situate Black girls and science discourse in the context of the rap cypher model Emdin proposes (Dill & Zambrana, 2009; Emdin, 2010). Instead, this intersectionality lens would constitute a critical analysis that probes into the “sexuality, gender, class, and popular culture, within a historical as well as a contemporary framework” (Dill & Zambrana, 2009, p. 3). This could potentially expose myriad of ways and resources girls of color draw on to navigate science discourse in the classroom. Moreover, Hill Collins states,

The unpaid and paid work that Black women perform, the types of communities in which they live, and the kinds of relationships they have with others suggest that African-American women, as a group, experience a different world than those who are not Black and female (1989, p. 747).

To situate this in the context of Emdin’s study, African-American girls may not feel comfortable engaging in various discourse styles with their African-American boy peers; using Emdin’s framework may lose sight of their perspectives and their own path to learning and engagement. Emdin does not give opportunities for readers to surmise what the viewpoint of these girls are, however (2010). Out of the thousands of vignettes analyzed, he provides only two examples, each involving young boys to explain how misinterpretation on the part of the teacher can lose sight on how well urban youth can
engage in the science classroom. A much more robust analysis of urban youth is needed that includes taking into account the roles and ways gender is enacted in the classroom.

Dance provides some insight into the lives of what the girls in Emdin’s research may experience based on Orenstein’s (1994) study of gender disparities in a public school. She specifically discusses the roles of low-income girls of color while observing their classroom behavior.

[D]evaluation by race or class does not preclude devaluation by gender… [G]irls are far more likely than boys to attend school on a regular basis… and tend to earn higher grades than boys But on those occasions when boys are equally represented [in the classroom]…boys grab the questions, …are rewarded for aggressiveness, [and] get whatever limited attention the teachers may offer… [Hence,] although underclass girls outshine and outscore boys scholastically through middle school, by high school they lose that edge and the boys begin to make disproportional gains. (Dance, 2009, p. 189).

Ultimately, a thorough examination among African-American girls in argumentation requires a lens open to viewing inequities on many levels. One important way that research can begin this is by first looking into the socio-historical context of these young women (Bowleg, 2008; Hill Collins, 2009). Understanding the history of racism, sexism and other oppressive forces for African-American girls that stems hundreds of years is extremely relevant when understanding their science identity and how these girls learn scientific argumentation.

2.2.2.9.7 Oliveira, Akerson, and Oldfield, 2012.

In one recent study that includes student identity in argumentation (Oliveira, Akerson, & Oldfield, 2012), the authors examine claims and supports of students during an environmental lesson; whereby students use cooperative concepts in their interactions with fellow classmates. Hence, the authors focus on environmental argumentation with a
group of Brazilian students. Oliveira et al. stress the paucity of studies that treat “student argumentation primarily as socioculturally neutral communicative events for the most part devoid of social identities and relationships” (2012, p. 870). In Oliveira et al.’s analysis of this type of argumentation, the key facets are the personal identity formation of students as well as their social interactions. Unlike previous studies on marginalized groups, the authors focus on the necessity of personal experiences and narratives as an absolute component in the process of argumentation involving SSIs.

Oliveira et al.’s framework is based in a socioconstructivist perspective “on the self” which stresses the dialogical processes in argumentation (2012, p. 872) and centers on language, personal identity, and the relevance to social identification. The authors stress that non-verbal communication or indexicality is also of importance in considering the discursive means of students as well as “footings” of individual students’; whereby students adopt certain positions moment-to-moment (Oliveira et al., 2012, p. 872).

The authors further distinguish themselves from other science education scholars that utilize identity by emphasizing the previous foci are typically out-of-school experiences where students have direct contact with the environment through community-based projects (2012). The authors here contend that their work focuses on these important environmental implications amidst the backdrop of classroom argumentation. Almost as an addendum, the authors focus on the paucity of sexuality inclusion in these types of studies. Instead, scientific argumentation studies focus on heteronormativity (i.e. the norms of heterosexuality). Their framework utilizes Grice’s cooperative principle which presumes informal logic through conversation (Oliveira et al., 2012). According to the authors, while the normative classroom practices use the
typical IRE response noted in previous argumentative studies, elementary students also enforce facets of Grice’s cooperative principle. According to Oliveira et al. (2012), “environmental argumentation, student identity, and language are intrinsically linked” (p. 873).

The general questions posed for this study focus on the types of claims and supports elementary students use in argumentation, how their personal identities construct these facets and how they use their own social interactions, based on Grice’s principle to negotiate the process of environmental argumentation.

The focus of this study is one 50-minute lesson in a fourth grade Brazilian classroom discussing environmental stewardship. The students were 30 fourth-grade students at a public school in Brazil. There were 13 females and 17 males. The students were of mixed descent (described as European, African, and Native) and were from poor rural areas.

The curriculum used in Oliveira et al.’s study was entitled “Project Wild and Population Connection” curricula. This curriculum includes “dilemma cards” (2012, p. 874) which give brief scenarios that students seek to solve about the wildlife. The study was examined via classroom discussions in Portuguese using three dilemma cards. The author reassures the reader that translation necessary for the teacher was literal and did not alter the actual narrative on the cards.

The authors used participant observation as a part of their research design. They also used video recordings of the classroom activities, including discussions. The teacher read the dilemma cards to the students and the first author facilitated classroom discussion. The authors emphasize that there was no instructional support in the
argumentation process. Oliveira et al. use Toulmin’s model to evaluate the claims’ structural components with the data (used as evidence). The data consisted of personal experience and anecdotes. The authors also utilized warrants as the support for the data to transition into the claim. The authors relied on a previous framework where warrants consisted of “social, economic, environmental, contextual, biocentric, and expertise” (2012, p. 876).

Oliveira et al. analyzed their data in two fashions, one involved a look at the students’ utterances, and other involved evaluating “key cultural scenes” (2012, p. 877). The latter encompasses pieces of conversation and not solely statements. The authors devised an interesting argumentative map that included the typical components of argumentation (claim, data, etc.), but claim to include a socio-cultural component that places significance on identity as part of their framework. The contention is that previous theoretical models of argumentation, as stated previously in this paper, do not seem to explicitly describe the students’ identities.

Indeed the authors found that the students used several types of warrants: social – with a focus on social relationships – economical, and environmental (Oliveira et al., 2012). The issue of gender is also introduced in the paper. For instance, the authors note that the girls sided with one female student who stated a claim in opposition to one made by a male student. The male student also had fellow male peers side with him.

The authors also point out that elements of Gricean’s cooperation principle surfaced during a discussion of a dilemma relating to a pet iguana at the zoo. One of the interesting findings associated with this study is a key cultural scene during the discussion of a fawn. In Portuguese, the authors describe that fawn has two meanings,
one of a small deer but also as a homosexual. The first author identifies himself as homosexual in this study, and spends a long period of time exploring the discussions that several students have in the class, identifying themselves as being anti-gay with their lewd comments. Oliveira et al. point out that these utterances seemed to provide an unsafe space for other students to explore the fawn dilemma.

Overall, the authors find that students used biocentric warrants when focusing on issues relating to the fawn and iguana. These warrants are defined as “[emphasizing] animals’ intrinsic right to wellbeing and safety regardless of their usefulness to humans (i.e., the importance of protecting animals for the animals’ own sake, not humans’ sake)” (Oliveira et al., 2012, p. 887). However, when discussing the dilemma card involving on and off light switching of the classroom, the focus was centered on human and economical rights. The authors stress that students may become emotionally indignant about certain issues and that educators should be mindful of this when developing curriculum that is environmentally-influenced as this is important in cultivating a pro-environmental stance.

This paper offers a refreshing picture in studying argumentation in a classroom of students of color. The authors explicitly acknowledge the students’ backgrounds, but not in a vague and neutral way, providing specific examples of how students’ identities influence the structure of their argumentation.

However, there were several limitations associated with this study. One involves the length of the data collection. Although an important starting point, extrapolating findings from a 50-minute lesson is not frequent or long enough to substantiate any of the authors’ claims. More time is needed to understand the students’ backgrounds. Although
identity involved in social interactions is moment-to-moment and ever-changing, a longer length of time is still necessary to help extrapolate these findings to other studies (Brown, 2004; Brown et al., 2005). Another limitation is that the dilemma cards used did not provide allowance for the use of evidence to support a claim. This is especially important because teaching students to rely on evidence is a necessary component in the teachings of argumentation. Indeed, studies in the United States by others (McNeill, 2011; McNeill & Pimentel, 2010) discuss the role of evidence and mention personal evidence, although not elaborately so. More studies that expound on the types of evidence used for students of color, particularly girls of color, are necessary.

Also, since this study took place in Brazil with the language of Portuguese, other societal and cultural factors come into play. It is not my intent to denounce these findings as being irrelevant towards the study of science education, as this provides background into the social context of argumentation for these students. However, it is quite difficult to use these findings when discussing marginalized groups in the United States with its own social, political, and cultural issues. Studies are still needed that will evaluate students, particularly girls of color and how their own unique and complex lives navigate the processes of argumentation in a hegemonic society.

Overall, the finding that this study is a very recent study published within the year at the time of this review may reveal that future studies are in process that will expound on argumentation from the standpoint of complex and detailed analyses of students of color.
2.3 Summary of Literature and Lessons Learned

The preceding literature on argumentation shows a general consensus of argumentation as a form of informal reasoning in science education, where alternatives are weighed side by side, and students rely on several personal resources to negotiate SSIs (McNeill, 2011; McNeill & Pimentel, 2010; Sadler & Zeidler, 2005, 2009; Venville & Dawson, 2009). Although the use of scientific evidence and rationalistic reasoning is used in resolving these issues, incorporating issues that target affective reasoning is encouraged (Sadler & Zeidler, 2005), though authors may differ as to what extent one mode should predominate (Sadler & Zeidler, 2005; Venville & Dawson, 2009). Studies also demonstrate to what extent students use personal resources, even relying on their own experiences as evidence to justify a claim (McNeill & Pimentel, 2010). In studies where diversity of student population is not in the forefront, scholars argue for the need to remain mindful of students’ backgrounds (Sadler & Zeidler, 2009) in order to personally engage this population. However, other scholars that strive for homogeneity of student population do so to ensure the quality of their results (Venville & Dawson, 2009). Studies also highlight that context matters (Sadler & Zeidler, 2005, 2009). That is, students’ reactions and, hence, modes of reasoning are dependent on the context of the issue. This seems to coincide with other scholars who contend that when students use their personal resources and experiences, they may be fraught with social, political, and other historical considerations (Rose & Calabrese Barton, 2012).

Scant literature exists that focuses on marginalized students, particularly with SSIs (Berland, 2011; Berland & Reiser, 2011; McNeill, 2011; McNeill & Pimentel, Oliveira et al., 2012). These studies focus on the much neglected area of urban students in
lower socio-economic environments, however. The studies illustrate that students have a
difficult time connecting argumentation in the science classroom with argumentation in
their daily lives as a way to understand this practice and skill (McNeill, 2011; McNeill &
Pimentel, 2010) and that student engagement may be lacking (Berland, 2011). The
studies also explicitly argues for the importance of understanding students’ cultural and
linguistic backgrounds when teaching argumentation (McNeill, 2011; McNeill &
Pimentel, 2010) or implies that such understanding is necessary (Berland, 2011; Berland
& Reiser, 2011). Studies that incorporate identity are also lacking in argumentation with
the exception of one study (Oliveira et al., 2012). However, this study focuses on
Brazilian students and not the marginalized groups located in the United States, two
vastly different populations geographically and historically. This review highlights a gap
in argumentation literature that requires a need for studying marginalized groups
indicative of their cultural, general, and racialized backgrounds.

The goal of national organizations such as the NRC is to help create standards that
will aid students in becoming scientifically literate (2011). One of the most significant
ways that this can occur is engaging students into the practices of science, which includes
familiarizing them into the language of science. One such discourse, arguably the most
important one, is engaging in the practice of scientific argumentation (McNeill &
Pimentel, 2010; NRC, 2011). Teaching students to construct and evaluate claims and
relate them to evidence is a significant way to engage them fully into the practices of
science as well as prepare them for the socio-scientific issues that will encounter them for
the remainder of their lives (NRC, 2011).
The implementation of scientific argumentation in classrooms is relatively new (Berland, 2011; Berland & Reiser, 2011; Driver et al., 2000; McNeill, 2011; McNeill & Pimentel, 2010). However, this language – as seen with previous studies on science discourse – can impede student learning for non-dominant groups such as girls of color (Atwater, 1996; Brown, 2004; Brown et al., 2005; NRC, 2011). This is because the “normative” classroom as it stands typically depends on the “societal rules” (NRC, 2011, p. 277) in which it resides. These rules stem from the dominant or hegemonic culture (i.e. White, middle-class etc.) (Atwater et al., 2010). This occurs even in classrooms where the dominant culture is not the majority, such as in urban areas that are poverty-stricken (NRC, 2011; Zambrana & MacDonald, 2009). Such students then face “cultural conflict” as the cultures of these students do not fall in line with the culture of science taught by teachers that often are vastly different from their own (Atwater, 1996; Brown, 2004). In this way, science acts as a “gatekeeper” for the non-dominant culture (NRC, 2011; Zambrana & MacDonald, 2009).

The NRC states,

…concerns about equity should be at the forefront of any effort to improve the goals, structures, and practices that support learning and educational attainment for all students…issues related to equity and diversity become even more important when standards are translated into curricular and instructional materials and assessments (2011, p. 277)

The conceptual framework created by the NRC provides two main sources of educational inequity currently existing in K-12 schools across the country (NRC, 2011). The first are inequities that exist “in schools, districts, and communities” resulting in “reduced opportunities to learn” (NRC, 2011, p. 279). This in turn results in achievement gaps that exist primarily for Black, Hispanic/Latino and American Indian students while women
are continuing to be underrepresented in the sciences (NRC, 2011). The NRC argues that these reduced opportunities continue to be one of the most imperative hurdles for educators and education administrators to climb with students drastically bearing the burden (2011). This is because there are many schools – particularly in urban areas with high poverty rates, that lack the proper resources (i.e. materials, tools, qualified teachers) needed to properly teach science (Barton & Tobin, 2001; NRC, 2011).

The second inequity involves teacher instruction that excludes certain “student populations” (NRC, 2011, p. 279). The NRC agrees that a student’s race, gender, language, and socio-economic class, among others, determine the type of access she will have to a quality education (Barton & Tobin, 2001; NRC, 2011; Zambrana & MacDonald, 2009). Though the conceptual framework lists these two problems separately, they are undoubtedly interrelated. Providing an education that excludes non-dominant groups such as girls of color will not take into account their own interests. This could result in achievement gaps or disengagement from science as has been shown in previous studies (Atwater, 1996; Atwater et al., 2010; Brown, 2004; Brown et al., 2005; Calabrese Barton, 2001).

Also shown in science education literature is the use of a critical lens when exploring classroom practices such as science discourse – particularly using theoretical frameworks that explore identity formation (Brickhouse & Potter, 2001; Brown, 2004; Brown et al., 2005; Calabrese Barton, 1998, 2001; Carlone, 2003, 2004; Carlone & Johnson, 2007; Johnson et al., 2011). The use of identity as a framework has been extremely beneficial in exploring the interaction between social identities such as race and gender, and how formation of these identities may constrain or facilitate the forming
of a girl’s science identity (Brickhouse et al., 2000; Brickhouse & Potter, 2001; Carlone, 2003, 2004). Hence, incorporating identity formation in research is fruitful for several reasons. First, it can improve learning by advancing school practices in the hopes that students may go on to become future science professionals (Carlone & Johnson, 2007). Second, for those that will not follow this path, these individuals may still become well-informed citizens who are able to handle the socioscientific issues confronting us every day; becoming every-day scientists, in this regard. Third, this framework allows for a deeper and more probing look into the racialized and gendered backgrounds of girls of color (Johnson et al., 2011). The NRC reinforces these reasons by stating that “instruction that builds on…identity is likely to be as important as instruction that builds on knowledge alone” (NRC, 2011, p. 287).

One significant problem upon perusal of literature is the paucity of research in understanding how African-American girls engage and learn scientific argumentation as a form of discourse and as an important practice of science. Indeed, at the time of this literature review, current research in scientific argumentation lacks the much needed lens of identity as a useful framework. However, in order to create a more inclusive science education, understanding the unique backgrounds and everyday experiences of students is necessary in order to engage students and improve student learning. (Calabrese Barton, 1998; McNeill, 2011; McNeill & Pimentel, 2010; NRC, 2011). As stated by the NRC, “Teachers pursuing a culturally responsive approach to instruction will need to understand the sense-making practices of particular communities, the science-related values that reside in them, and the historical relationship that exists between the community and local institutions of education” (2011, p. 284).
Framing this in the context of scientific argumentation then means that teachers should immerse themselves in the everyday lives of students – particularly from non-dominant cultures to best understand how to teach this language of science (McNeill, 2011; McNeill & Pimentel, 2010). As the NRC states in the previous quote, part of this involves a look into the “historical relationship” between schools, and their communities (NRC, 2011, p. 284). Atwater et al. reminds us, however, that “the dominant ideologies embody power and influence educational policies and practices in the United States” (2010, p. 288). If such communities are low socio-economic urban areas, then the need to examine them with a critical lens that takes into the socio-historical context of the people of these communities – such as novel identity frameworks – becomes imperative.

Current research in scientific argumentation from urban communities riddled by poverty lack this lens (McNeill, 2011; McNeill & Pimentel, 2010; Berland & McNeill, 2010; Berland & Reiser, 2011; Berland, 2011). Though such work is instrumental in bringing scientific argumentation to urban communities, keeping them engaged in the study of argumentation requires a deeper and more complex study into their lives. Understanding their lived experiences in this light may motivate and enlighten these students – especially girls of color – into moving on to become professional scientists or the everyday scientists needed in our society today.
CHAPTER 3

METHODOLOGY

3.1 Research Design

I begin this chapter by restating my research questions. I then describe the rationale for my use of microethnography and discourse analysis by discussing their associated epistemologies. I also attempt to operationalize the concept of identity as it relates to discourse analysis. I then describe the research site, data sources and methods of analysis. At the end of this chapter, I describe the organization of the remaining chapters.

3.1.1 Research questions

Because of the exploratory nature of this research, I created research questions that were rather broad. I wanted to make sure that I did not limit myself in what I decided to observe in the classroom. However, I still surmised several possible questions that could help answer these broad questions as a way to remain focused in the sea of data (please see bulleted statements along with the research questions. In the beginning of this study, these questions served to act only as a heuristic, to guide my thinking. However, as I continued with the study and noticed arising patterns in my observations (via field notes and audio and videotapes), other questions did arise, such as mental health, which I needed to include. My research questions for this study were:

1a. What are the characteristics of discipline-focused discussion for African-American girls in a high school science classroom?
• What actions (verbal and non-verbal) would I observe from African-American girls as they engaged in argument-based activities in class?

1b. How would analysis of these discussions and student written work look when guided by an argumentation model and feminist theoretical framework which values the roles of lived experiences of an individual?

• Would African-American girls use characteristics of sympathy and empathy in their use of evidence for a claim as outlined by the Black feminist theoretical framework?

• Would these characteristics (e.g., sympathy and empathy) stem from their own lived experiences unique to their identities as African-American girls (i.e. involving race and gender, etc.)?

• Would these lived experiences act as a scaffold to understanding how the African-American girls in my study make or evaluate a claim?

2. How does the nature of the classroom climate relate to how African-American girls practice argumentation?

• Do the African-American female participants in my study view themselves as active and contributing individuals in argument-based classroom activities?

• Are they viewed as an active and important role in argument-based classroom activities from their peers?
Broadening the concept of lived experiences

Three days after I began making observations, one of the participants, Darlene, caused me to question how I approached this study, or at least prompted me to rethink the focus of my research questions. As I was sitting waiting for class to begin, Darlene came up to me and told me that her hands were really dry. Sympathetic to this cause, I immediately told her that I had lotion and/or oil that she could use for her hands. She was not satisfied with my offer, however. Instead, she replied that her hands “would still feel dirty”. I must have looked confused because she admitted to me then that she suffered from obsessive compulsive disorder, and had to wash her hands many times in an hour (approximately 12 times). I was speechless for a couple of reasons. I was really surprised that she admitted something so personal to me in such a short time. Yet, my own familial experiences with mental health made me sympathetic. With respect to my study, however, I wondered what this could mean. This was extremely relevant to Darlene, I felt, because she told me this with little prompting at such a short time into the study. I also surmised that from this admission, this must affect her role as a student. I realized that I would need to revisit my research questions to allow for experiences like these into my study. I decided to not only to look at lived experiences as a way for African-American female participants to reconcile, state, and evaluate claims as they engage in argumentation, but also how these experiences related to their abilities to learn this skill as a social practice in the classroom. For instance, do their lived experiences impact their attendance in class, cause distractions to learning argumentation, or impact them in other ways? In other words, I took elements from my research questions: lived experiences from the use of argumentation described in research question one and the social context
of the classroom in research question two to reframe how I evaluated these participants as they engaged in scientific argumentation.

3.1.2 Rationale for methodologies

3.1.2.1 Social constructive epistemology

The literature review in chapter two brings up significant findings relating to non-dominant groups and science discourse (Brown, 2004; Calabrese Barton, 1998; Carlone, 2004), particularly scientific argumentation (Berland, 2011; Berland & Reiser, 2011; McNeill, 2011; McNeill & Pimentel, 2009). However, specific literature relating to African-American girls and their use of scientific argumentation was lacking at the time that I began this study. Consequently, this study was exploratory in nature and relied on a research design that coincided with the open-endedness needed to understand the lived experiences of these girls, how they reflected their social identities, and the classroom culture that influenced how they engaged in argumentation (Creswell, 2008). A social constructivist worldview holds several assumptions necessary for this type of study (Barton, 2001; Creswell, 2008; Lincoln & Guba, 1985). From this perspective, individuals hold various meanings of their life experiences and other phenomena and it is the job of the researcher to search for the “complexity of views rather than narrowing meanings into a few categories or ideas” (Creswell, 2008, p. 8). Even more, such meanings occur via interaction with others and have social and historical influences – relying on the norms embedded in these students’ lives (Creswell, 2008). Lincoln and Guba also remark that one assumption of the corresponding methodology is that the construction of individuals may be expressed through interacting with the researcher and
other participants (1985). Hence, through dialogical interactions with the researcher, a more polished understanding of the construction is obtained.

One common methodology that stems from the social constructivist perspective is the use of ethnography (Agar, 1997; Shaffir, 1999). Ethnography, as mentioned in previous sections, involves “…attempting to describe, analyze, and interpret social expressions between people and groups” (Shaffir, 1999, p. 676) or understanding “…who are these people and what are they doing” (Agar, 1997, p. 1163). This is typically done through the use of prolonged research at the field site in question, and data collection methods such as the use of field notes and semi-structured interviews (Cohen & Crabtree, 2006).

3.1.2.2 Critical epistemology

Due to the specific nature of the research itself, which focuses on the lived experiences of a historically oppressed race and gender (Calabrese Barton, 1998, 2001; Haraway, 1986; Harding, 1992), engaging in research that understands that “oppression frames the social construction of knowledge and the nature of the experience” is also paramount in this project (Calabrese Barton, 2001, p. 912). This methodology forces the researcher to see education (both curriculum and its pedagogical practices) as rooted in political and cultural norms (Calabrese Barton, 2001). Because such practices are politically and culturally motivated, it follows that studied interactions in the classroom are rift with unequal distributions of power and oppression (Calabrese Barton, 2001). However, another important notion is the power of human agency (Anderson, 1989; Calabrese Barton, 2001; Pane & Rocco, 2009). In this sense, structures of inequality, such as racism, classism, and sexism are not simply ideologies reflective of a dominant
culture (Anderson, 1989), but are instead actively constructed and produced by individuals in the classroom (Anderson, 1989). This involves acts of resistance from students that seek to challenge current conditions to “produce their own” (Pane & Rocco, 2009, p. 7).

3.1.2.3 Ethnography

Emerging from the field of anthropology and sociology (Agar, 1997; Jeffrey & Troman, 2004; Spindler & Spindler, 1987), ethnography serves to uncover the particular nuances of social interaction and has yielded fruitful results (Jeffrey & Troman, 2004). Researchers are typically concerned with analyzing the “complexity of social structures and relations” (Jeffrey & Troman, 2004, p. 535), “…attempting to describe, analyze, and interpret social expressions between people and groups” (Shaffir, 1999, p. 676) or quite simply understanding “…who are these people and what are they doing” (Agar, 1997, p. 1163). All goals similarly involve placing the researcher in the midst of their field site (Agar, 1997; Shaffir, 1999) with the purpose that use of this methodology is “theory generating” (Agar, 1997, p. 1162).

Agar describes several different points relating to the principles of conducting ethnographic research. First, participant observation occurs where the research observes the phenomena first hand (1997). Second, observing research first hand allows for unexpected instances to occur that are not initially understandable, called rich points (Agar, 1997). These rich points are considered qualitative data since they are “gaps…between two worlds of experience that is exactly the problem that ethnographic research is designed to locate and resolve” (Agar, 1997, p. 1157). The two worlds consist of the different perspective offered by the researcher as well as the person, group, or
culture under study (Agar, 1997). The last is coherence, where the responsibility falls on the researcher to understand the rich points. Agar describes this as understanding the “context” of the action which results in “coherence” (1997, p. 1157).

Jeffrey and Troman describe the principles of ethnographic research from both a methodological and theoretical perspective (2004). Ethnographic research must be conducted over time to allow for a wide range of instances to occur that may be observed or analyzed, often to allow for contradictory circumstances. Continual reflection is necessary. Ethnography must also take into account the societal, cultural, and political context of the institution and community from which it is embedded. Lastly, a theoretical framework must be incorporated to allow for progression on substantiated theories or to develop new theory.

3.1.2.4 Microethnography

This research, which explored how African-American girls engaged in argumentation, required evaluating student articulations as a way to understand how they conceptualized these arguments (McNeill & Pimentel, 2009). Consequently, a microethnographical approach was required for this type of analysis (Au & Mason, 1982; Bloome, Carter, Christian, Otto & Stuart-Farts, 2005). Microethnography involves the use of flexible data collection methods that aid in analyzing the “… participation structures in lessons to be studied, and socio-cultural differences in interactional rules examined” (Au & Mason, 1982, p. 1). In particular, studying participants who are from culturally different backgrounds have benefited from this approach (Au & Mason, 1982). It evaluates the use of language in peer-to-peer and teacher-peer interactions and "allows the researcher to evaluate social processes such as language within is own socio-political
context (Bloome et al., 2005). Video-taped observations of these interactions are typically an important role in the use of microethnography (Au & Mason, 1982) and discourse analysis was used to uncover more information on my participants’ identities and lived experiences (Bloome et al., 2005).

3.1.2.5 Discourse Analysis

Discourse analysis aids in exploring the social intricacies involved during classroom interactions. This type of analysis is more than just a method that falls under the umbrella of microethnography, however (Bloome et al., 2005). I specifically relied on the approach by Bloome et al. (2005), which contains theoretical constructs of identity that align with the theoretical framework for this study (i.e., Black feminist and intersectionality theories). The theoretical basis that shapes this type of discourse analysis views classroom interactions as complex and ambiguous, fraught with identity processes and power relationships in a socio-cultural context (Bloome et al., 2005). That is, language in and of itself is extremely contextual. However, the actors in the classroom are also active agents, continuously creating new meanings in language as they interact with one another, which also leads to dynamic changes in the formation of their identities (Bloome et al., 2005). Placed in the context of this study, engaging in the practice of argumentation reflects one’s identity (to be discussed in the next section) as well as aids in the construction of it (Bloome et al., 2005).

3.1.2.5.1 Identity.

Before going further, it is important to unpack the definition of social identity by Bloome et al. (2005) as a way to frame how I approached analyzing identity for this
study. I was drawn to Bloome’s approach to discourse analysis because his definition of identity is similar to other science educators and researchers who use identify formation in order to understand student learning (Brickhouse & Potter, 2001; Calabrese Barton, 1998; Carlone, 2004). First, because my research involved studying the social groups to which an individual belongs to both inside and outside of the classroom, my definition of identity is broad to encompass the membership into a racial, ethnic, or gender group etc., as it relates to their roles in the classroom. It was important for me to not only study how the race, class, and gender of these girls influenced their roles in an argument-based classroom, but I also attempted to understand the various roles they may have in their school (i.e., top science student, musician, athlete, etc.) in the time I observed them. Bloome et al. terms this view of identity as a type of social classification or membership (2005).

Still, the preceding view is also limiting in that it implies that this appellation is fixed. In actuality, the meanings of one’s identity changes depending on the individual, the context, social interaction, etc. (Bloome et al., 2005). Also, the identities relating to an individual’s race, class, and gender are not separate from their other identities and may help further define unique identities (Weber, 2001; Zambrana & Macdonald, 2009). Bloome et al. suggests that viewing identity as fixed eliminates the important social processes and dynamics involved in identity formation. Language is the vehicle through which these identities are constructed and negotiated (Bloome et al., 2005). Evaluating language as a social process allowed further insight into the characteristics of group membership. Consequently, I was also interested in the identities of my participants and how they are labeled in the social context of the environmental science classroom. As
stated in the last chapter, Brickhouse and Potter describe this process as “[the] ways in which one participates in the world and the ways in which others interpret participation” (2001, p. 966). In the context of my study, it involved understanding how they engaged in debate and argumentation, as well as how others interpreted this participation (Brickhouse & Potter, 2001). As already described in a previous section which states my research questions, this additional social element also holds the assumption that the other students in the classes evaluated the participation of African-American girls in various ways as they engaged in debate in this environmental science classroom. For instance, in a small group discussion in which one of my participants, Bailey, attempted to state a claim for the most important animal to champion in light of global warming, she struggled to think of the proper animal from a film shown in the classroom. Her classmate, an African-American male named Xavier, teased her when she faltered in her recollection, “What are you even talking about?” He asked as she stammered while attempting to recall the name of this animal. She quickly laughed and stopped guessing and remarked, “I don’t know!” in an exasperated fashion. This single episode, admittedly removed from its context, may suggest that her male classmate did not support her as she created her argument, or at least, did not take her answer to be very serious. In actuality, Xavier and Bailey were good friends that constantly “ribbed” on each other in Mr. J.’s classroom as will be described in the next chapter. In any case, this still provides a sound example of what occurred when exploring the dynamics of the classrooms as these participants engaged in debate or argumentation.
3.1.2.5.2 Power.

Commensurable with the previous section and with my theoretical framework, discourse analysis as described by Bloome et al. views the analysis of power as a another dynamic process that uncovers revelations concerning individuals and institutions in relation to each other (2005). Bloome et al. emphasize the significant role of the researcher and the way she may perceive her field site and enact her role in the research context (2005). Discourse analysis also accommodates Black feminist thought and intersectionality theory in that power is a dynamic process through the ever-changing uses of language (Hill Collins, 2000; Weber, 2001). Because of the complexity and varying ways power is often represented, it was important for me to understand that discourse analysis may only uncover a small part of the roles of students, teacher, and researcher in the classroom (Bloome et al., 2005). Although I did take the role of power seriously in my study, I did feel comforted knowing that my analysis would probably not do the issue of power justice because of my own perspectives as a Black woman, which would realistically bias the study to some extent. Such findings were necessary to reveal, but I hoped that the discourse analysis would be a worthwhile way of uncovering it.

3.2 Context

I began my doctoral research with the intent of studying a science classroom in an urban district. This arose from my literature review, which states that such areas are in dire need of equitable resources (material, curricular, and pedagogical) (NRC, 2011). However, at the time that I sought teachers for the study, the urban district in mind was undergoing a major upheaval in its school system. Many teachers were transferred from
their usual positions or fired as an attempt to improve the drastically low student test scores and to close wide educational gaps between its district and other surrounding schools. Hence, many teachers that I contacted were understandably disinterested in having a strange doctoral student evaluate their classroom practices. I finally found Mr. Johnson (pseudonym), who taught in a school located in a neighboring suburban town. This school district, Riverwest (pseudonym) did not have the low numbers as the urban district but ended up being a fine research site for this novice researcher. This is because Mr. J (as I will refer to him from now on) was an eager seasoned teacher who fervently believed in my project. When I initially presented my research idea to him, he immediately wished aloud that I was in his class a previous semester where he noticed interesting exchanges between two African-American girls in his class with drastically different backgrounds. His easy-going manner and flexibility to include my study into his classroom agenda made me feel increasingly comfortable as the study progressed. My criteria soon changed from studying African-American girls in a high school biology course to studying these girls in Mr. J.’s high school environmental science courses.

Riverwest High school is located in a suburban town in the Midwestern part of the United States. The median income in Riverwest as of 2012 was $47,976 (city-data.org, 2013). The African-American population in this district is 14.0% with a 9.5% Hispanic population. This community is a fairly peaceful one, with crime rates that are below the national average and with the most common occupations occurring in manufacturing and retail. This is no surprise as one drives through the heart of the community, which houses several expansive shopping plazas.
The school itself is an impressive one in several ways. There are approximately 2600 students with 700 students located in the Freshman (9th grade) building. There are 47.12% White students, 29.34% African American, 8.44% Hispanic, 9.82% Asian American, 0.57% Native American and 1.34% Multi-racial. (schoolmatters.com). My first thought as I walked through the hallway the first days of my research while students hurriedly – or not so hurriedly – moved from one class to the next was the incredible diversity of the student population. Not only did I notice a wide array of racial backgrounds, but it was interesting to see the different styles of students, some that seemed to go against widely held stereotypes for certain underrepresented groups. I have thought often that this school could be featured on television as the idyllic picture of diversity as far as high schools go – at least in the hallways. However, in the classrooms that I observed, I also noticed some racial division, with most African-Americans assembling together during class.

Though Riverwest does not hold any special distinction which describes the school as either underperforming or high-achieving, it does list an important challenge of the school – to close the achievement gap between “the high 30% and the bottom 30% (2013-2014 school annual report, p. 1). The large and diverse population of Riverwest is not limited to the cultural groups that make-up the school. Perusing the school report reveals that there are variations in academic achievement. For instance, the school boasts impressive statistics such as 367 students who take part in Advanced Placement (AP) courses and 55 students who were dually enrolled in colleges in 2013-2014. However, only 20% of students are considered proficient in science. These often jarring statistics represent the potential disparities that occur on such a huge school campus.
3.3 Participants and Sampling

Because I worked only with Mr. J, I was limited to those who enrolled in his environmental science classes. Mr. J teaches two regular environmental science (RES) courses and one Advanced Placement environmental science (APES) course. However, from these courses, nine African-American girls agreed to be a part of this study. In the first RES course, four African-American girls agreed. In the second, two African-American girls agreed. In the APES course, there were three African-American girls that agreed to participate in my research. The female participants ranged in grade levels from 11th to 12th grade. Please see Table 1 which provides general demographic information on the participants.

Table 1
Demographics of female participants

<table>
<thead>
<tr>
<th>*RES African-American female participants</th>
<th>*APES African-American female participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maya – age 17- Senior, single parent (father)</td>
<td>Amber – age 17- Senior, Two parent</td>
</tr>
<tr>
<td>Brandy –age 17 – Senior, single parent (mother)</td>
<td>Kylie – age 16 – Senior, single parent, mother</td>
</tr>
<tr>
<td>Darlene – 16 – Junior, single parent (mother)</td>
<td>Amy –age 17 – Senior, single parent</td>
</tr>
<tr>
<td>Janice – 17 – Senior, single parent (mother)</td>
<td>(mother)</td>
</tr>
<tr>
<td>Bailey – age 17 –Senior, single parent (mother)</td>
<td></td>
</tr>
<tr>
<td>April – age 16 – Junior, single parent (mother)</td>
<td></td>
</tr>
</tbody>
</table>

Note. Names are pseudonyms to protect the identity of the participants.

All students in these classrooms returned consent forms stating their interest in participating in the project. For those that did not (two African-American girls) and eight other students, I made sure to either not include them in video shots or erase their
statements in transcripts if they were included. All together, there were 48 RES students (25 students in 1st and 23 in second) and 28 APES students in these classes with my participants. As an incentive to return consent forms (whether participants agreed or not to be included in the study), Mr. J provided extra credit.

The instructor and classroom

Mr. J is an exemplary African-American high school environmental science teacher who has taught at Riverwest School for over 20 years. He holds a bachelor’s degree in marine biology from a well known historically Black university. I have had informal conversations with students and staff in regards to his reputation. In these conversations, as well as in interviews with the participants, I have found similar positive remarks. Previous students have visited Mr. J. and told me that Mr. J was their favorite teacher in this high school.

One math teacher, upon finding out that I was performing research in his class, exclaimed, “You’re in the coolest classroom in this school!” Mr. J does have an impressive classroom that has been featured in a local newspaper. He has housed hundreds of animals over the years. The main purpose of such a large collection of animals is two-fold. He primarily uses these animals for two project-based courses he teaches in addition to the environmental science courses I observed for this study. In the project-based courses, students create their own studies with Mr. J’s guidance using a certain animal and are responsible for maintaining the study the remainder of the course. Aside from this formal goal, students that do not take his classes will often wander in to look, hold, and ask questions relating to the different reptiles and animals. Mr. J’s easygoing personality and passion for environmental science has gained him a
respectable reputation within the school and district. He has acquired grants and funding over the years to maintain his classroom. At the time of this study he had just recently moved into a remodeled classroom, one that was significantly bigger than his previous classroom. This room could fit an extra column of four 10-gallon sized tanks in his classroom.

Ten days after I began this study, Mr. J found that he was dissatisfied with the classroom set-up. He asked me to help him move the tables so that it would be easier for him to weave around the student tables and interact with his students in a more efficient manner. Figure 4 is the set-up of the classroom for the remainder of this study. Figures 5 to 7 provide the seating arrangements for the participants in the RES and APES classes.

3.4 Instruction and Curriculum

Mr. J. employs a curricular design that is a mixture of formal textbook material, films, simulations, labs, and case studies in his environmental science courses. He designs the curriculum for students in grades 10 to 12. The course description for RES reads,

This course focuses on the interactions between people and their environment. Students will develop an understanding of how various eco-systems interact to create the common environmental problems facing our society. This course will involve environmental problem solving using critical thinking and decision-making skills. Students will analyze, discuss and debate current issues concerning the environment” (Riverwest course description book, 2013-2014, p. 25).
Figure 3 Original set-up of Mr. J.’s classroom

Figure 4 Revised set-up of Mr. J.’s classroom
Figure 5 Seating arrangement of first hour RES students

Figure 6 Seating arrangement of second hour RES students
I have outlined general differences in my classroom observations of RES versus APES in Table 2. One example of a classroom activity in RES, involved a town hall simulation in which students took the roles of various groups that were either for or against the addition of businesses to a nature park. These groups were county commissioners (the decision-makers), friends of nature, citizens, and the Chamber of Commerce. The groups discussed the construction of a lumber mill in a nature park. Students viewed various examples of positions and created their own position statements within their groups. They then debated these positions in class. Such an activity provided students the opportunities to evaluate and critique each other’s claims as will be discussed in Chapters 4 and 5 (NGSS, 2013).
Table 2

General activity differences between RES and APES classes

<table>
<thead>
<tr>
<th>RES</th>
<th>APES</th>
</tr>
</thead>
<tbody>
<tr>
<td>More active reading of textbook</td>
<td>Some active reading of case studies</td>
</tr>
<tr>
<td>material to understand</td>
<td>Discussions/debates critiquing</td>
</tr>
<tr>
<td>environmental science concepts</td>
<td>environmental case studies</td>
</tr>
<tr>
<td>Town Hall Simulation</td>
<td>Laboratory component – self-designed study</td>
</tr>
<tr>
<td><em>Planet in Peril</em> (Environmental film focus) and presentation of argumentation-based questions</td>
<td>Field trip</td>
</tr>
<tr>
<td></td>
<td>More challenging scientific component</td>
</tr>
<tr>
<td></td>
<td>(carbon, nitrogen cycles, etc.)</td>
</tr>
</tbody>
</table>

The APES course description states that successful completion of this class is equivalent to completing a semester of college-level introductory environmental science. Students use a more challenging textbook than the RES students – one that focuses more heavily on difficult scientific concepts such as the carbon and nitrogen cycles. APES Students also critique environmental case studies in class – something not done in the RES courses. In addition, APES students took part in a field trip along a popular Midwestern river. Mr. J. informed the students that they were to design their own experiments for this field trip. They also had the opportunity to collaborate with other students on the findings of their studies. This provided a potential place to discuss various claims. This was Mr. J.’s second year teaching APES compared to the 20 years he taught RES and he was still finding ways to modify the course. Mr. J. accepted these students into his APES course based on the students’ grade point averages and interest as well as academic promise. He spoke several times of “recruiting” these students into his APES class.
3.5 Instrumentation, Data Sources, Data Collection

In my study, I performed data collection, transcription, and analysis concurrently. For instance, on a typical day involving data collection, my general schedule involved collecting data in the morning at Riverwest school (from approximately 7:30 a.m. – 12:30 pm). For the remainder of the day when I had no other duties, I spent time transcribing and organizing my field notes/and writing analytic memos. This was necessary to stay on task and to help with subsequent observations. When I transcribed, I typically performed preliminary coding using my a priori codes as a guide (see Figure 9 and Tables 5 and 6) (Saldana, 2009). These codes helped frame my analysis but led to other codes, themes, and patterns. I also began to set up my tables for formal discourse analysis (Bloome et al., 2005). These steps helped inform my first set of interviews. Shortly before I conducted interviews, I was able to begin formal discourse analysis. The previous steps allowed me to feel adequately prepared for the interviews. Second interviews were conducted as a form of member-checking. Discourse analysis was completed and allowed me to write my results for this study. In the following sections, I separate data collection and data analysis for ease of discussion.

3.5.1 Data sources

3.5.1.1 Classroom Observations

I videotaped and audio-recorded classroom events for approximately 3 hours (1 hour for each class)/day, 5 days a week as a way to capture group and classroom discussions relating to their classroom work (Pane & Rocco, 2009), a total of approximately 15 hours per week. This was done from September 8, 2014 to October 31,
2014, for approximately 8 weeks of data collection. Within this time period, there were
days that I did not observe classes due to special assemblies, holidays, etc., There were
also days in which students did not take part in any argumentation-based activities but
still took part in other activities such as active or silent reading. Tables 3 and 4 show the
daily activities from this time period, with check marks indicating when I conducted
observations. Mr. J. was a helpful resource in discussing these dates beforehand.

Table 3

Daily activities for RES classes

<table>
<thead>
<tr>
<th>Activity</th>
<th>Date</th>
<th>First Hour/RES</th>
<th>Second Hour/RES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Field</td>
<td>Audio</td>
</tr>
<tr>
<td>Film</td>
<td>9/8</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Film</td>
<td>9/9</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Film</td>
<td>9/10</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Film</td>
<td>9/11</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Film/Quest</td>
<td>9/12</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Film</td>
<td>9/15</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Film</td>
<td>9/17</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Film/Small Group</td>
<td>9/18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Presentations</td>
<td>9/22</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Presentations</td>
<td>9/23</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Speedy Day</td>
<td>9/24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Classwork</td>
<td>9/25</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Classwork</td>
<td>9/26</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Vocabulary</td>
<td>9/29</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Classwork</td>
<td>9/30</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Article Review</td>
<td>10/1</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Field Trip</td>
<td>10/2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Town Hall Prep</td>
<td>10/3</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

Classroom observations (from the videotapes, audiotapes, and field notes) were
my primary way of understanding the nuances involved in how the
African-American female students engaged in argumentation. It helped to substantiate findings of student written work (e.g., the town hall debates) versus their written position statements, and helped answer the second question which required an analysis of the classroom dynamics.
### Table 4

**Daily activities for APES class**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Date</th>
<th>Field</th>
<th>Audio</th>
<th>Video</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case Study</td>
<td>9/8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Case Study</td>
<td>9/9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Case Study</td>
<td>9/10</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Case Study</td>
<td>9/11</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Quiz</td>
<td>9/12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Book Review</td>
<td>9/15</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Book Review</td>
<td>9/17</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Lecture</td>
<td>9/18</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Classwork</td>
<td>9/22</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Classwork</td>
<td>9/23</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Speedway</td>
<td>9/24</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quiz</td>
<td>9/25</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quiz</td>
<td>9/26</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Field trip prep</td>
<td>9/29</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Field trip prep</td>
<td>9/30</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Not applicable</td>
<td>10/1</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Field trip</td>
<td>10/2</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Field trip debrief</td>
<td>10/3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Lab</td>
<td>10/6</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Lab</td>
<td>10/7</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Lab</td>
<td>10/8</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Test/Case Study</td>
<td>10/9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test/Case Study</td>
<td>10/10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test/Case Study</td>
<td>10/13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test/Case Study</td>
<td>10/14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lecture</td>
<td>10/15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Classwork</td>
<td>10/16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technical difficulties</td>
<td>10/17</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Field trip presentations</td>
<td>10/20</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Field trip presentations</td>
<td>10/21</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Vocabulary work – in class</td>
<td>10/22</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vocabulary work - in class</td>
<td>10/23</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vocabulary work - in class</td>
<td>10/24</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Case study</td>
<td>10/27</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Case study</td>
<td>10/28</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Case study</td>
<td>10/29</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Quiz</td>
<td>10/30</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test</td>
<td>10/31</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Preliminary coding guided by grounded theory (Strauss & Corbin, 1990) during these observations helped guide me in subsequent classroom observations as well as in the formal discourse analysis.

When Mr. J. advised me that an argumentation-based activity would take place, I was able to plan the placement of my cameras and audio-recorders, as well as where I would sit during the class periods. Typically, Mr. J. utilized small group activities. During those times, I would place an audio recorder on the table by my participants as well as a video camera nearby facing the participants. As expected, students were initially very mindful of these devices. However, they eventually seemed to slowly acclimate to my presence, making jokes with me and teasing me about the equipment. Some students were comfortable enough to eventually discuss school events, gossip about other students, curse, and even discuss their feelings about the teacher on these recordings.

In making observations, this data source aided in “document[ing] language activity during classroom lessons” (Pane & Rocco, 2009, p. 11). The whole classroom, including Mr. J, was observed. In particular, the linguistic evidence was studied as accurately as possible which encompassed both verbal and non-verbal behavior for students and Mr. J. as well as any other individual in the classroom (Bloome et al., 2005; Pane & Rocco, 2009). This will be discussed further when I describe the conduction of data analysis during this period. The first two days of observations consisted of a practice run and was not considered data. Instead, this allowed opportunity for the students and I to become accustomed to the equipment (e.g., technical and logistical issues), the participants, and any other potential issues that would arise in a typical videotaped session specific to the project (Pane & Rocco, 2009). During this time, students became
acclimated to the equipment at their tables, while I understood proper placement of the observation equipment (video recorders and audio recording devices) to capture the best images and sound quality.

As a researcher involved in an ethnographic study, I was very mindful of the Hawthorne Effect, and how this would reflect the responses and actions of the students (Coombs & Smith, 2003). Coombs and Smith, however, express their frustration that educational research seeking to evaluate the effectiveness of a curriculum and other social interactions found in the classroom may be invalidated by some individuals due to this phenomenon (2003). Also, the authors assert that the “humanistic paradigm rationale of ethnographic inquiry” requires the need to use observations to evaluate these social discourses (Coombs & Smith, 2003, p. 101). Incidentally, the only way I could really alleviate this effect was to sit in the class for two days with the previously described practice run to allow students time to adjust to my presence and equipment. I also was constantly mindful of this limitation as I transcribed and collected field notes and made notes of this in my analytic memos.

3.5.1.2 Field notes

Field notes were an important part of my data second to my audiotaped and videotaped observations. I relied on a resourceful iPad app (aptly named “Field Notes”) to type in field notes as a way to “augment [the] data” of what was found on the videotape and audiotapes of classroom events (Pane & Rocco, 2009). These notes were recorded as needed, approximately 5 days a week (3 hour/day). I took these prior to, during, and following each classroom visit as often as possible. Prior to the beginning of class, these notes recorded observations relating to the participants already in the
classroom and unique resources that Mr. J provided for the day (i.e., map of town hall simulation recorded on the screen). These observations also recorded any unusual events that occurred relating to the participants (i.e., Darlene relating her obsessive-compulsive behavior). These notes attempted to record verbal and non-verbal behavior of the participants and their surrounding peers from chosen classroom events as a way to substantiate what was recorded on the video and recording devices. They also noted any special artifacts being used and activities taking place (e.g., special laboratory equipment, film viewing, etc.). Field notes taken subsequent to the end of class relayed any other circumstances that may have occurred during the extent of the classroom, including pronouncements regarding the next class period from Mr. J. The convenience provided by this iPad app (automatically time stamping each observation and facilitating upload to my Dropbox account) made it easy for me to type copious notes at various points throughout the classes. The notes did not attempt to write conversations verbatim, as this would have prevented me from missing other important occurrences. I relied on audio recorders and video recording equipment to capture the exact verbal exchanges. The field notes and analytic memos (described in an upcoming section) were used to provide a more holistic picture of the classroom events. These field notes and analytic memos were particularly helpful to guide my understanding of the various classroom dynamics while African-American girls engaged in argumentation-type exercises (see the second research question). They also helped to enhance and compare data analysis with other data sources and potentially reduced researcher bias (Pane & Rocco, 2009; Rajendran, 2001).


3.5.1.3 Analytic Memos or Analytic Induction

Data analysis was ongoing, involving analytic induction, from the beginning of data collection to help minimize the rigorous process of analysis, to help inform me for both sets of interviews, and to eliminate researcher bias (Smelser & Baltes, 2001). The helpfulness of analytic memos cannot be understated for this research. Smelser and Baltes explain the formal function of these sources.

Analytical induction calls for the progressive redefinition of the phenomenon to be explained (the explanandum) and of explanatory factors (the explanans), such that a perfect (sometimes called “universal”) relationship is maintained. Initial cases are inspected to locate common factors and provisional explanations. As new cases are examined and initial hypotheses are contradicted, the explanation is reworked in one or both of two ways. The definition of the explanandum may be redefined so that troublesome cases either become consistent with the explanans or are placed outside the scope of the inquiry; or the explanans may be revised so that all cases of the target phenomenon display the explanatory conditions. (2001, pp 1-2)

Smelser and Baltes discuss the importance of analytical induction as an ongoing conceptual process that helps the research redefine new data as the study progresses (2001). Saldana more pointedly describes the practical approach of keeping analytic memos, places where one may “dump your brain” (Saldana, 2009, p. 41) when using coding or when taking field notes. Analytic memos are typically used to relate oneself to the study, reflect on the research questions, coding choices, or emerging themes or patterns. In my case, it was helpful for me to write analytic memos in my field notes.

After easily uploading the field notes to Dropbox, I was able to organize the field notes in a tabular manner using Microsoft Word, where the first half displayed the field notes and the second half contained my analytic memos. Although these were eventually copied to a qualitative analysis software program, I found that keeping these memos while
collecting the data maintained my focus on the research questions amidst all the seemingly overwhelming data.

3.5.1.4 Student written work

I collected any available student written work with an argumentative element from September 8 to October 31, 2014 for coding of argumentation themes. Such work included student work during classroom projects, completed hand-outs, and student responses to formulated questions related to the textbook material. This was not a reliable data source, however, because there were instances where participants chose not to turn in their school work. In addition, I found that the RES students did not use a significant amount of written argumentation as compared to the APES students. Still, it was an additional source that was helpful to provide context to the classroom activities.

3.5.1.5 Interviews

I conducted semi-structured interviews with all participants in the study during as a way to support written work and classroom observations. Cohen and Crabtree describe specific components of semi-structured interviews.

The interviewer and respondents engage in a formal interview. The interviewer develops and uses an 'interview guide.' This is a list of questions and topics that need to be covered during the conversation, usually in a particular order. The interviewer follows the guide, but is able to follow topical trajectories in the conversation that may stray from the guide when he or she feels this is appropriate. (2006, p. 1).

In this study, semi-structured interviews were used with the intent of uncovering biographical data, beliefs of environmental science and Mr. J’s class, and their use of argumentation. These interviews were also used to uncover any possible lived
experiences. However, questions were open-ended to allow participants to express themselves freely and openly without constraints of the interview. Two sets of interviews for each participant took place; with the latter conducted as a form of member checking. The first set of interviews occurred during the week of October 27, 2014; after I transcribed and performed preliminary analysis of a good portion of the data. This occurred subsequent to two very important activities, the town hall simulation from the RES course and the field trip for the APES course. The second set of interviews occurred during the week of December 15, 2014; approximately six weeks after the end of direct classroom observations. Kylie was the only participant that did not agree to the second interview. At the time of the second interviews, I was at the end of my discourse analysis, and used the interviews as an opportunity to use a form of member-checking proposed by Carlson (2010). According to Carlson, the researcher brings in portions of data analysis to the interview so as not to overwhelm the participant. Participants then view the researcher’s assigned themes to their responses and discuss if they agree or not with these patterns. The participants agreed with my coding 100% of the time and only found disagreements with miscellaneous typos (2 times) or strangely worded statements (1 time). In these instances, I offered to fix the typos and listen again to the audio-recordings. If I could not resolve the worded statement, I would remove it from data analysis. Overall this method was successful. The one exception was Darlene, who began to still feel overwhelmed with the passages. In response to this, I directed her to the bolded phrases that facilitated my assignment of such themes.

There were several general reasons for conducting these interviews. One purpose of these interviews was to help expose any possible use of lived experiences in the
environmental class work and related identity processes found in observed episodes. For instance, one of my assumptions in the beginning of the study was that if the emotive domain was used by my participants in providing reasoning for their use of evidence; this could potentially provide a concrete understanding of their lived experiences which stemmed from social identities (social location). If that was the case, my questions would then attempt to focus on explicating these lived experiences by questioning their use of reasoning in certain scenarios.

Interview questions also helped provide context for classroom events that explored the dynamics of social discourse between students as these African-American girls engaged in argumentation (2nd research question). In this instance, I brought in video and audio clips at times to the interview that dealt with the specific dynamics of how the participants acted in the group with their peers. Please see Appendix B for the interview protocols that I used in my study.

As stated previously, second interviews were also conducted to clarify responses made during the first interview. I also had informal conversations with Mr. J. throughout the course of the study to better understand the reasoning behind certain lesson plans and for feedback regarding expected or unexpected classroom events. These conversations were not recorded. However, I did record information from these sessions in my field notes following these conversations if I felt it aided in the analysis of my data.

3.5.2 My role as participant-observer

My role as an ethnographer in this study allowed me the flexibility of being a participant observer in research settings (Dewalt & Dewalt, 2011). However, this role varied based on the type of class. This confirmed literature that describes the continuum
of participant-observation (Dewalt & Dewalt, 2011). More specifically, the RES classes were much more formally structured compared to the APES class. In the RES classes, Mr. J had a set agenda that included the students participating in activities such as active reading, silent completion of class work, and presentations. Also, two of my participants in this class, Brandy and April, typically came in late for various reasons which reduced the chances of me interacting with them. Because of this, I rarely had time to truly bond with the RES students compared to the APES students except before and after class. I was able to talk with Darlene and Maya more, because they often hung around Mr. J’s desk because of Darlene’s special academic needs and Maya’s mentoring relationship with Mr. J. In this way, I felt as though they began to trust me as they opened up about their diet, mental health, and extracurricular activities. Brandy developed a certain level of professional trust in me when I aided her small group in presentations. I provided my iPad to replace their Whiteboard information for a presentation (I had taken a picture of this previously as an artifact and the Whiteboard was accidentally removed from the classroom). From that point on, she would often come to me and verify certain instructions that Mr. J provided to the class when she was tardy. I believed that this helped me with the interviews. Ultimately, my role progressed from someone who sat silently by a small desk near the instructor taking field notes to one who often answered questions concerning assignments for class, collected class and home work, proctored quizzes and exams, received attendance slips from tardy students, and gave permission for hall passes to students while Mr. J attended to other teaching responsibilities.

In contrast, I had more opportunities to engage with the participants in the APES class. Mr. J allowed these students much more flexibility because the assignments he
constructed allowed for more collaborative activities between other students. Students often freely walked around, discussing their ideas with each other. Because of this classroom culture, I felt increasingly comfortable to do the same. In the beginning of the study, I often set up audio recorders and video recorders by the participants to acclimate them to my project without being too intrusive. However, this progressed to me also walking around, navigating between different groups and taking field notes and participating in some of the students’ informal activities such as holding the various lizards, spiders, and snakes in the classroom and helping the students with the equipment needed for certain projects. In these experiences, I truly felt as if I played the role of an ethnographer because as I recorded data, the students often included me in their discussions, asking me questions and inviting me into their conversations. I happily did so, because they were an interesting and friendly class, but also because I knew this would help me with the upcoming interviews. In particular, one student from APES, Kylie, initially seemed intimidated by me. However, the APES field trip along a Midwestern River helped her feel more comfortable around me. She admitted her fear of riding a canoe in the water the previous day. In response to this, Mr. J and I made sure that during the trip, her canoe (which she rode in with Amber who was afraid as well) was held tightly to our own canoe until they felt comfortable riding on their own. Her relationship with me, though still slightly formal, did relax somewhat because of this.
3.6 Data Analysis

3.6.1 Challenges and choice of software

Please see Table 5 for the steps I followed in analyzing the data for my study. Discourse analysis in this study prompted me to develop different ways to accurately organize my data while keeping track of my various arising themes. However, it was not too long after I began preliminary analysis via coding using the modified McNeil & Krajcik model (2012) that I realized I needed to revisit my choice in software. I needed to find a program that was sufficient to provide an in-depth look into my data with Bloome et al.’s approach (2005). The main benefit of discourse analysis – explicitly stating the linguistic evidence for arising themes – was in danger of getting simplified by qualitative analysis software (Bloome et al., 2005). However, a primary concern was staying organized and keeping track of the emerging codes, themes, and patterns that would inform my results. I chose to email Dr. Bloome himself to obtain his advice on the best approach and he confirmed my suspicions, - that there was no perfect qualitative analysis software that worked with his approach. He recommended a wide array of software, including Transana as well as Microsoft Office. However, he stated that everyone who used his approach found , to his knowledge, “ that [the software] actually has limited use and…have to create some work-arounds or invent other systems” to really obtain the full benefits of his method (private communication on 10/11/2014). Hence, I decided to do the same.

Discourse analysis requires an analytical lens when perusing transcripts, the construction of social maps, etc. (Bloome et al., 2005). I used Microsoft Excel and Word to construct the discourse analysis templates and maps
In addition, I chose software that could aid in the digitization of these constructs to better manage my data. I borrowed from Paulus, Lester & Dempster (2013) whose view on reliable software that facilitated discourse analysis appealed to me.

Table 5

Steps in overall data analysis

<table>
<thead>
<tr>
<th>Steps</th>
<th>Data sources used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transcribe data sources</td>
<td>Videotaped /audiorecorded classroom segments</td>
</tr>
<tr>
<td>Code all student written work with argumentation elements using modified McNeill &amp; Krajcik model as heuristic/conversation functions as needed.</td>
<td>Student handouts and other relevant written work. (Research question 1)</td>
</tr>
<tr>
<td>Preliminary analysis/discourse analysis (coding of general themes) including argumentation coding</td>
<td>Videotaped /audiorecorded classroom segments (Research questions 1 and 2)</td>
</tr>
<tr>
<td>Begin writing results of dissertation</td>
<td>Videotaped classroom observations, student written work, field notes (Research questions 1 and 2)</td>
</tr>
<tr>
<td>Conduct first set of interviews</td>
<td>Videotaped classroom observations, student written work, and written work (Research questions 1 and 2)</td>
</tr>
<tr>
<td>Transcribe interviews</td>
<td>First set of interviews (Research questions 1 and 2)</td>
</tr>
<tr>
<td>Partial discourse analysis/grounded theory</td>
<td>First set of interviews (Research questions 1 and 2)</td>
</tr>
<tr>
<td>Continued discourse analysis of data sources</td>
<td>Videotaped segments (Research questions 1 and 2)</td>
</tr>
<tr>
<td>Conduct second set of interviews for member checking</td>
<td>First set of interviews, classroom observations, student written work, field notes (Research questions 1 and 2)</td>
</tr>
<tr>
<td>Transcribe interviews</td>
<td>Second set of interviews (Research questions 1 and 2)</td>
</tr>
<tr>
<td>Partial Discourse analysis /grounded theory coding</td>
<td>Second set of interviews R. 1 and R. 2</td>
</tr>
<tr>
<td>Overall analysis of data/finish writing results and discussion of dissertation</td>
<td>Videotaped classroom observations, student written work, field notes, both sets of interviews (Research questions 1 and 2)</td>
</tr>
</tbody>
</table>

In this light, I viewed the software as a way to effectively manage my data, aid in finalized transcription of my video and audio recordings, and as a reliable way to present my findings. I chose MAXQDA 10 – a commonly used software for qualitative research as a way to store the transcribed video segments; particularly in regards to argumentation and classroom dynamics. MAXQDA 10 allowed me to break down my transcript into the appropriate message units. I relied on the “memo” functions to add in the
contextualization cues and linguistic evidence that supported my division of the transcripts. The coding function allowed me to capture the themes and patterns that arose from the data and use them consistently. This made it easier to compare with interview themes and patterns as well. Because of the iterative process of qualitative research, it was helpful to easily modify the themes and patterns as I went through the data. The “document memos” function also allowed me to add in field notes and analytic memos that would help as needed with the transcripts so that all my data was in one place. The following sections provide in-depth descriptions of the various ways I used discourse analysis for each data source.

3.6.2 Discourse analysis

3.6.2.1 Organization

For discourse analysis of data sources, Bloome et al. discuss basic theoretical tools that are essential in this approach (2005) and will be described in the upcoming sections. The purpose of these resources are to help the researcher conceptualize and provide possible explanations for the discourse events at hand. Even more, these tools provide ways to examine the social assumptions involved in classroom discourse. These tools required iterative viewings and hearings of the video and audio recordings and field notes.

3.6.2.2 Entry points

In order to begin analysis, I used videotaped observations and field notes to note the particular entry points I needed to focus on for discourse analysis (Bloome et al., 2005).
The main goal of entry points is to help capture video segments of the classroom event that are indicative of the whole lesson that you are observing (Bloome et al., 2005). Originally, I had 49 video clips that I recorded via consultation with Mr. J. Entry points were determined by a combination of iterative viewings of the video recordings, referring back to the research questions and identifying contextualization cues – nonverbal or verbal ways that people make their intentions known to social others in a particular act or event (Bloome et al., 2005; Green and Wallat, 1981). With the use of entry points, I was able to create 61 video segments of the video clips to transcribe and analyze further.

3.6.2.3 Other discourse analysis tools

In delineating between different classroom events, the use of boundary making is also necessary (Bloome et al., 2005). Boundary-making consists of “message units” that hold a “shared meaning” (Bloome et al., p. 21) based on the context of a particular act. Boundary making is important so that ethnographers may understand what is occurring and how to analyze its significance. In these situations, researchers look for how people may provide cues to each other in a way that is socially created (Bloome et al., 2005). This is ascertained by looking at the videotape with the event along with the corresponding transcript.

I also assessed the thematic coherence by viewing the video transcripts and videotapes. This involves looking at how meanings are organized in an event. These themes can be isolated or overlapping and are often made explicit by how participants “question and/or contest what is happening either through verbal or nonverbal interactions (Bloome et al., 2005; Pane & Rocco, 2009). Thematic coherence, evaluating whether students in the class understood the subject matter of the classroom activity, for
example, is useful in uncovering findings that may substantiate how one identifies oneself in science, and other racial and gender roles (Bloome et al., 2005).

I also noted the intertextuality, or the shared meaning between two different texts which can be verbal, non-verbal or written (Bloome et al., 2005; Pane & Rocco, 2009). Pane & Rocco provide a helpful example of students taking notes in class, reading from books, and talking with others in the classroom simultaneously (Bloome et al., 2005; Pane & Rocco, 2009). In my own study, for example, this was often translated into students discussing their answers to individual class work/homework questions in small groups.

In addition, video segments were identified based on the phase unit of the clip. Phase units are larger and may consist of a number of interaction units (Bloome et al., 2005). Examples of phase units are discussions, lectures, active reading, etc.

As a way to remain organized with each video segment, I noted the thematic coherence and intertextuality involved in the clip. Boundary-making was more implicitly ascertained by evaluating entry points. However, with the entry points, I made sure to note why I established this point in the Microsoft Excel program.

3.6.2.4 Operationalizing the term “argument”

In the following sections, I describe how I used discourse analysis to answer my research questions with the general template that I used to begin my analysis. I discuss how I attempted to understand the ways my participants learn argumentation vis-à-vis lived experiences and their social identities. However, before this, I must operationalize the term “argument” for this study and discuss the modified McNeill & Krajcik model
that I used to initially help guide my evaluation of the argumentation in this study as a part of discourse analysis (2008; 2012).

Approximately one month into my research and upon viewing the variety of ways that students engaged in argumentation (both written and oral), I felt that my previous definitions of a scientific argument were not sufficient enough to allow me to choose which artifacts and classroom events to analyze. I also wanted to be as consistent as possible in my analysis of the data at hand. This was important to me because I needed to ensure that I had the right amount of latitude to include any and all elements of how my participants engaged in argument and debate. By this time, NGSS provided a handy appendix that clearly delineated the goals of various grade levels and helped me to focus my research (2013). Please see Table 6 for these guidelines. The left hand side provides my own interpretation of the NGSS standards. The right side presents how I translated these points to fit these guidelines into my study. The bullet points on the left hand column do not correspond to the bullet points directly beside it in the corresponding right column but the general importance involves my translation of NGSS into this study.

In addition, I still relied on my initial modified McNeill & Krajcik model (2012). Please see Figures 8 and 9 for both the original and modified versions. The modified model was helpful in guiding analysis of how the participants in the study may create and evaluate arguments as they engage in argumentation, but it was by no means exclusive. I address additional findings in chapter 5 of this dissertation. Flexibility was necessary because Mr. J was not relying on the CER-R framework when instructing his students. Additionally, microethnographic methods must impart some flexibility to remain aligned
with its methodology (Au Mason, 1982). It was important for me to remain relatively open in my analysis to ensure that I was capturing the data as wholly as possible.

In the modified version, tenets of feminist philosophers and argumentation scholars are implemented to help delineate the types of evidence and reasoning used and take into account lived experiences (Calabrese Barton, 1998; Gilbert, 1994; McNeill & Pimentel, 2010; Sadler & Zeidler, 2005). These terms must be explicitly defined in order to guide my categorization of types of evidence and reasoning that may emerge in my findings.

3.6.2.5 *Scientific and personal (anecdotal) evidence*

In brief, analysis involved relying on Kolsto (2001) and McNeill & Pimentel’s (2010) definition of scientific and personal evidence. Scientific evidence is “any data that scientists use to investigate this phenomenon” (McNeill & Pimentel, 2010, p. 210). This could be “glaciers melting, sea levels rising, and species disturbance” in regards to climate change (McNeill & Pimentel, 2010). Kolsto further describes this evidence as “statistical evidence” because such data can be made “public, intersubjective, and open to validation for anyone interested” (Kolsto, 2001, p. 302). In contrast, he describes anecdotal evidence as “evidence presented by citizens” (Kolsto, 2001, p. 302). This type of evidence is a broader category from which personal evidence is a subset (2001). McNeill & Pimentel discuss personal evidence as “information that stems from personal experiences…” (McNeill & Pimentel, 2010, p. 211).

Consequently, in regards to personal evidence, it is assumed that the personal evidence will be based on the lived experiences of students as described by Hill Collins (2000), and as indicated in the modified CER-R model. Analysis of personal and
scientific evidence was determined by assessing whether the evidence described stems from lived experiences or if it is scientific data that is found from the resources available to the

Table 6
NGSS argumentation goals for 9-12 students

<table>
<thead>
<tr>
<th>General goals</th>
<th>Translation to specific study</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Engaging in argument from evidence in 9–12 builds on lower grades and advances to understanding the use of scientific evidence and reasoning in their support of claims. Arguments may stem from past or present events.</td>
<td>• Evaluate assignments that ask to state, defend, and critique claims about the environmental science topics in Mr. J.’s classroom</td>
</tr>
<tr>
<td>• Analyze conflicting arguments or create new ideas in the face of novel evidence or explanations about the natural world, including ethical implications.</td>
<td>• Evaluate written work, presentations and small group discussions where students must discuss competing arguments in environmental issues</td>
</tr>
<tr>
<td>• Evaluate the typical elements of the argument in light of current scientific explanations to assess the validity of such arguments.</td>
<td>• Evaluate written responses to class/home work that prompts students to evaluate opposing claims; observe discussions where students argue about environmental issues.</td>
</tr>
<tr>
<td>• Respect differing viewpoints on various issues; evaluating differing perspectives and considering these in light of one’s own argument.</td>
<td>• Evaluate student written work and small group or whole classroom discussions where students must provide and receive critiques on arguments related to various environmental issues.</td>
</tr>
<tr>
<td>• Using data, construct and evaluate arguments. Understand the use of evidence in these arguments</td>
<td>• Evaluate position statements from town hall simulations, and other presented issues. Observe presentations that present arguments and counter-arguments based on data provided by the instructor.</td>
</tr>
<tr>
<td>• Use evidence to learn how to construct claims.</td>
<td>• Evaluate student written work and small group discussions/presentations that prompt students to make/defend a claim based on films, proposal of a lumber mill being constructed on a natural ecosystem preserve and other case studies.</td>
</tr>
</tbody>
</table>

Note. General goals of the NGSS are modified and not reproduced.
students, such as statistical data and other graphical representations, etc. Chapter 4 will discuss the role of topical evidence in this study.
3.6.2.6 The various domains of reasoning

Based on literature from scholars inside the area of science education, argumentative theorists and feminist philosophers, I initially created a table that provides a list of components associated with each domain of reasoning. Please see Tables 7 and 8 for the initial domains and the associated characteristics of each. The domains were created based on Sadler and Zeidler’s findings (2005), Gilbert’s classification of the various types of arguments (1994), and Hill Collins Black feminist epistemology (2000).

In regards to the cognitive domain, Gilbert defines the rational domain as “reasoned, linear, and orderly” (Gilbert, 1994, p. 163). He describes rationality or logic as containing information that “takes its information, for example, warrant, backing, evidence, from traditional rationalist sources…” and where the “traditional” notion in this definition may still be left to question (1994, p. 166). Sadler and Zeidler describe this as “reason-based considerations” (2005, p. 112). For instance, the students in their study involving gene therapy incorporated information regarding the financial costs, further division of social class, and evolution into the rationale of their arguments (Sadler & Zeidler, 2005). These authors also clearly consider reason and logic as characterized by the lack of emotions but the inclusion of practical considerations (Sadler & Zeidler, 2005).

In terms of the emotive domain, literature describes the role emotions such as sympathy and empathy play in reconciling arguments (Hill Collins, 2000). In Black feminist thought, caring is actually a term that serves as an umbrella for other attributes (2000).

Caring contains three components, appreciating the uniqueness of an individual,
Table 7
Domains and associated factors (initial)

<table>
<thead>
<tr>
<th>Emotive Domain</th>
<th>Cognitive Domain</th>
<th>Intuitive</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Moral) Empathy (Hill Collins, 2000; Sadler &amp; Zeidler, 2003)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Moral) Sympathy (Sadler &amp; Zeidler, 2003)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Values (Carofiglia &amp; deRosis, Krahwohl et al., 1964)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 8
Initial codes for domain factors

<table>
<thead>
<tr>
<th>Emotive Domain</th>
<th>Cognitive Domain</th>
<th>Intuitive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caring (C)</td>
<td>Reason/Logic (R)</td>
<td>Immediate/gut level reactions (G)</td>
</tr>
<tr>
<td>(Moral) Empathy (ME)</td>
<td></td>
<td>Intuitive (religious, spiritual, mystical) (I)</td>
</tr>
<tr>
<td>(Moral) Sympathy (MS)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Values (V)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

understanding the need for emotions during discourse, as well as containing empathy or being able to “understand one’s position” (Hill Collins, 2000, p. 263). Further, Sadler and Zeidler discuss the prevalence of sympathy and empathy in literature and define it as an emotional reaction that includes feelings of concern for other individuals’ needs or “identifying with the characters in the SSI scenarios” (2005, p. 115). Hence, I did attempt to assess for these characteristics during discourse analysis while being mindful of other arising factors. As mentioned in previous sections, it was my assumption that the emotive reasoning would provide a concrete understanding of the lived experiences of the participants in my study.
Sadler and Zeidler (2005) affirm that intuitive reasoning involves reacting immediately to a situation without the use of rationality, an assertion that is supported by Gilbert (1994). Further, Gilbert contends that this may also include relying on aspects of one’s religion (i.e., mentioning of relationship with church or commensurable organized practice), spirituality (i.e., personal relationship with a higher power), and beliefs in mysticism (i.e., tarot cards). One assumption at the start of the study was that students may rely on these aspects that are associated with one’s lived experiences and would be coded as such in Table 8. Instead of specifically focusing on different aspects of an intuitive domain, I included all the aforementioned characteristics mentioned so as not to be exclusive before the start of the study. This was further explored through small group and classroom discussions and noted as such during coding and discourse analysis of transcripts. The interview questions sought a more comprehensive understanding of the argument structure used and its relation to the lived experiences (and identity processes) of the African-American girls in my study.

### 3.6.3 Student written work

All available written student work was assessed and coded for argumentation elements and domains of reasoning as guided by the modified version of the McNeil and Krajcik model. This written work was also analyzed to obtain any available information on how participants may have possibly used evidence or reasoning to justify claims. In the beginning, I relied on priori codes created before I began the research (Saldana, 2009). These codes were drawn from my proposed modified model of the McNeil and Krajcik model. Please see Tables 7 and 8. However, these were simply used as a heuristic until further codes (and eventual themes and patterns) emerged.
3.6.4 Classroom observations

In regards to the first and second research questions, I relied on Bloome et al.’s approach in the analysis of transcripts related to observations (2005). I modified several templates into one general template to be used in a simple Microsoft Excel program that is presented in Chapter 4. After organizing the transcript into message (and interactional units), I further organized the transcript into surface and underlying levels (Bloome et al., 2005). The surface level constitutes the superficial interactions that occur while performing different activities (Bloome et al., 2005). Bloome et al. relate this to actors participating in a performance in typical classroom culture (2005). The underlying argument level describes how the students and teachers together construct their own intentions.

For each of the surface and argument levels, I split them further into the conversational strategy/strategies and the location of knowledge (Green & Wallat, 1981). The conversation strategy serves to describe how the participants involved respond to each other (Bloome et al., 2005; Green & Wallat, 1981). In the surface level, conversation strategies are straightforward, typically a question or response. However, underlying levels are more complex as individuals may have up to 14 different strategies (Green & Wallat, 1981). Examples of various functions include restating, focusing, clarifying, and confirming. Descriptions of these strategies may be found in Appendix D and will be discussed throughout the chapter.

The location of knowledge placed in the discourse analysis template indicates which individual bears the content of the message unit (Bloome et al., 2005). The location of knowledge may be quite difficult to ascertain. For instance, in a discussion
between students, it may be jointly held or it may not. It is up to the discretion of the researcher to evaluate each message unit for its content and linguistic evidence (i.e., contextualization cues) to understand where the location of knowledge is held. The content of the participants’ messages as well as the way they presented themselves verbally and non-verbally were essential to understand their identity assignments (Bloome et al., 2005). The underlying assumption is that knowledge is viewed as a dynamic process that is co-constructed with various locations of knowledge (Bloome et al., 2005).

The remaining columns are relatively straightforward. The argument column lists any codes, themes, and patterns that occurred relating to the argumentation model that I modified as well as other unfolding themes. I also used this column to identify any lived experiences. These codes were generally color-coded for easy reference. Interaction units indicate how message units are connected. These are larger portions of a conversation, consisting of more than one message unit and which serve to specify the shared activity of the participants (Bloome et al., 2005; Pane & Rocco, 2009) of the event. The social interaction indicates the participants involved in the message unit. The identities indicate what processes are highlighted in the message unit from the speakers. The linguistic evidence helps reinforce the contextualization cues that support the identity processes of the message unit. Lastly, the uptake across the interaction unit gives primary information on where the location of knowledge is found for the message units.

Data related to argumentation, non-verbal behaviour, and identities were transferred to the MAXQDA 10 software application for data organization. In instances where the participants did not speak at all (i.e., was not the source of a conversational strategy), I added in an extra
column specifying their non-verbal behavior so that it could be noted in MAXQDA 10. As noted before, I could then code for other themes that are discussed in Chapters 4 and 5.

**Assessing power in classroom observations**

Discourse analysis utilizes a more straightforward approach when evaluating power. Bloome et al. argue for an analysis of power that fleshes out the boundary of a classroom event (2005). This includes understanding who is involved in the event, what is occurring, and how this event relates to others as examined by the researcher. Ultimately, this analysis included the possibility of uncovering how the relationships between students, teacher, research and social institutions are viewed and any associated ideologies that would account for these relationships (Bloome et al., 2005).

Bloome et al. suggest evaluating videotaped lessons as occurring in multiple phases to ensure that a complete picture of the power relationships is understood (2005). This would also result in viewing how these relationships are maintained or transformed throughout a lesson. To begin this analysis, I selected an entry point for the lessons I observed as described by Green and Wallat (1981) and in my previous section (Bloome et al., 2005). Defining the individuals and what is occurring in the event relies on actual evidence to support these questions. Hence, I relied on artifacts such as written class work, pictures of presentation boards etc, - the physical component of the classroom – to assess this difficult relationship. In essence, I viewed the entire context of the exchange (Bloome et al., 2005).

Bloome et al. also suggest researchers ask themselves what individuals in the classroom event are attempting to construct as well as the associated socio-cultural or
economic ramifications (2005). Hence, the worlds could involve the world of the classroom and the world that the teachers and students interpret from the SSI class assignments. However, contextualizing this power relationship (i.e., understanding what has occurred before the event and after) also provides a fuller picture of the use of power in an event (Bloome et al., 2005). To help provide the context for these interactions, as viewed from the participants, the use of videotape feedback interviews are necessary. In this way, when at all possible during my semi-structured interviews, I asked my participants to view some video clips to interpret particular events. During this time, I remained mindful of the level of uncertainty with this method due to the length of time between the interview and the previewed event (Bloome et al., 2005). I was also mindful of this important concept when viewing each video segment on my own.

3.6.5 Interviews

Semi-structured interviews were assessed as described in the previous section. Unlike the original intent, I chose not to use discourse analysis with the interviews as I did with the videotaped transcripts. This is because I did not want the participants to feel self-conscious with a video recorder directed at them while I asked sensitive questions. Instead, I chose to rely on regular coding of themes in a grounded theory fashion (Saldana, 2009). Still, there were times that I relied on conversation strategies to present the findings from these interviews as found in Chapter 4.

3.6.6 The researcher and minimizing bias

The research design of this qualitative study, being ethnographic in nature, required steps to ensure that my own biases did not significantly affect the findings of
this study. Rajendran describes different areas in qualitative research in which biases on the part of the researcher may occur (2001). These include selection biases, such as sampling of participants, times, events, different interview questions, etc. (2001).

In order to curtail some of the bias, I needed to first reflect on my personal experiences as an African-American woman (and my previous experiences as an African-American high school girl) in the beginning of the study. One in which I admired the role of science and its place in the world (and my place in it) while enduring bouts of racism and sexism in the classroom. In this way, I was able to be mindful of my past and present social locations (Weber, 2001). This needed to be maintained as the study progressed. I did not find this difficult as just being in the environment of the high school conjured up some old personal memories of my own experiences. In these cases, analytic memos also helped me take a more objective stance as I described in a previous section.

My social location also includes my role as a doctoral candidate in science education as well as a part-time instructor in a local Christian college that is considered a predominantly White institution (PWI). Related to my work, I also reflected on my seven years of science teaching experience in PWIs. I thought of my educational experience in which I completed my M.S. in Biology at Western Michigan University. My research related to my M.S. degree also involved racial disparities although it stemmed from a public health perspective. In that project, I evaluated Whites and African-Americans with Type 2 diabetes and hypertension from socio-economically disadvantaged areas. In my various research projects, I realized that, through my own lived experiences, addressing such disparities, health or educational, was necessary in order to find solutions for
marginalized individuals to remain healthy and receive the best education afforded to them, respectively.

My social location provides important information about my science identity. My project constantly brought up my own lived experiences and the ways I formed my science identity as a child and woman. As a young girl, I was considered intelligent. However, a move from a very diverse city to a small town that was predominantly White strongly affected my views of my own science identity. During my first year at the high school where my father moved us, my own science teacher made racist remarks to me – prompting a quick meeting between him, my parents, and the principal. Though the science teacher never made negative remarks to me following this meeting, I will never forget this event. This hurtful experience as well as others demonstrated to me that I could not separate my identities as an African-American girl from a student that enjoyed science, no matter how hard I tried. I now know that there is no need for me to separate these identities. I feel that my identities as a biologist and science teacher are interwoven with my identities as an African-American mother and wife. More specifically, how I view myself in science is partially determined by my own lived experiences as an African-American female. Although I undoubtedly brought these biases to the study (and they remained throughout the study), these events have also driven me to pursue this type of work. My views have extended beyond simple integration of the various identities of African-American females, however.

I also had to integrate my feelings on argumentation as it relates to my own beliefs. I understood that constructing arguments involved stating a claim and supporting it with evidence. I also felt that students should learn how to provide reasoning for the
types of evidence used. However, I knew that students rely on evidence that may stem from their own personal experiences as stated in literature. For the participants in this study, their lived experiences as African-American girls with their various identity roles may determine the evidence and reasoning they use in learning argumentation. As stated in my theoretical framework (and supported by literature) I believe that these various identities are created through lived experiences and that lived experiences help form identities – both should not be ignored in the classroom. In fact, this information may be beneficial in their learning argumentation if teachers learn to understand and appreciate these differences – eventually developing culturally relevant approaches to teaching argumentation.

Another way that I reduced researcher bias in this study was through triangulation of data sources. Triangulation of field notes (as well as analytic memos), videotaped and audio taped observations, interviews, and student work helped to substantiate research findings, and provide validity to my conclusions (Mathison, 1988; Rajendran, 2001). In my second set of interviews, implementing member-checking also aided to reduce my bias. Lastly, frequent consultation with my dissertation committee aided me in proper ways to remain more objective in my study.
CHAPTER 4

RESULTS AND ANALYSES

4.1 Introduction

In this chapter, I will share results of the analyses involving the direct classroom observations, written work, and corresponding interviews. The results will be divided into six main sections. Section 4.2 describes the use of argumentative elements in the construction and evaluation of scientific argumentation that took place among the participants. Section 4.3 discusses the use of lived experiences in the study. Section 4.4 discusses the gatekeepers – as described by Zambrana and MacDonald (2009) that arose in this study when including lived experiences as it relates to the social context of the argumentation-based activities. Section 4.5 discusses identity formation during the construction of arguments and as it relates to the social context of the argumentation-based activity. Section 4.6 discusses phase and thematic shifts of classroom lessons as it relates to the instructor’s implementation of scientific argumentation in his classroom. Section 4.7 summarizes the findings detailed in this chapter. To accurately discuss video segments under analysis, selected excerpts have been segmented into lines with assigned numbers and the quotation marks removed. The removal of the quotation marks and addition of line numbers are helpful to discuss the various conversation strategies and argumentation elements the participants in this study used (Green & Wallat, 1981; McNeill & Krajcik, 2008, 2012).
4.2 Argumentation Elements in Classroom Practices

Because, I don’t know, the environment is, like, everything. Because that’s where we live. And, like, the whole thing where they’re trying to move the park is unnecessary and I just thought, ‘They’re just messing with nature for no reason; when it could have just stayed the same. Just adding more pollution and all this other stuff that we don’t need.’

April, junior, study participant

Please see Appendix D for a tabular description of the discourse conventions and symbols used in classroom quotes and discourse analysis tables throughout chapters 4 and 5. This section will discuss the various examples of arguments the participants engaged in without an explicit model used in the classroom. My intention is to demonstrate that these students approached constructing and evaluating arguments in various ways. These ways were connected – in part – to the context in which these activities took place. For relevant conversations that are analyzed in the body of the text by line, the passages will have line numbers. Other quotes not requiring analysis will not have these numbers.

4.2.1 Variation in classroom activities and arguments

Because of the various levels of flexibility and choice of instruction imparted by Mr. J for the RES and APES students, I observed the use of argumentation manifest itself in various classroom approaches. For RES classes, small group discussions followed by a classroom presentation of the results of such discussions typically occurred alongside written work (which was sparse in terms of argumentation). Students were either asked to create position statements (e.g., town hall simulations), discuss previously constructed responses to assigned questions (e.g., case study) or given group questions directly to discuss amongst themselves (e.g., town hall simulations). It was easier for me to uncover
the use of argumentation from the RES students during this time. One reason for this was that students were required to give presentations after their discussions. In addition, although Mr. J. did not use an explicit model like that of McNeill and Krajcik, he was clearer in his instruction to the RES students compared to the APES ones (2012). For instance, in one RES activity that required students to present their discussion responses, here are his detailed instructions.

Okay. The first question your group is going to discuss is, come up with a comprehensive – that means everybody’s input – answer. Overall, do you think their efforts – talking about environmentalists – have been successful in the examples in this program? And then, based on whatever you guys come up with as a opinion, why or why not? Back it up; substantiate it. Give some credibility to your answers. Not, yes, I think they’ve been successful. But why? What proof do you have? How you gonna back it up? Okay?

For the town hall simulation, he stated,

With whatever time you’re using, use it to get your arguments. Get your personal arguments ready. Here’s [sic] my questions, concerns, things I’m going to bring up, so you’re ready to go tomorrow. Because here’s the situation, guys. Listen, man. I know it’s Homecoming week and I love the energy, but you gotta listen. Convincing these folks (Mr. J. gestures towards the county commissioners) you need a lot of talking points. Because, inevitably, someone is going to get up and say your point. You’re going to be saying, ‘Oh, man’, which means you need to have a lot of stuff ready to go. ‘Cause otherwise you’ll have to think on the fly. You’ll have to think of things really quickly. You’ll have to think, ‘If the situation changes; five of my points just went up in smoke ‘cause someone just beat me to the podium and brought ‘em up.’ They don’t wanna hear that ten times. Or if they do, they’re going to be like, ‘Okay you made your point.’ But it’s not getting your group anywhere. It’s not getting them anywhere. It’s not getting you any farther up the road with them. It’s not getting you farther up the road. So if you got a number of talking points, then you’re ready to go. And things will change where you may get up to the point, where you may use a rebuttal or something. But the point is…you need to be prepared for tomorrow. Everybody, everyone has to come up here four times. You will lose points if you don’t. This will be fast-paced tomorrow. My job is to keep you organized in terms of coming up and down and making sure no one is breaking the rules. Everybody with me on that? But, literally, when we come in? The time it takes me to take attendance and we’re done. And when you come in tomorrow, you need to be in your groups. In your groups.
In contrast, Mr. J. gave the APES students much more flexibility when it came to understanding the content of argumentation-based questions and limited the amount of instruction. Results will be presented by each class – RES and APES – for ease of presentation.

4.2.2 RES classes

Table 9 contains a summary of the main RES argumentation elements used during classroom activities. If participants used these elements at least once, it was placed in the table.

Table 9
Argumentative elements of RES students

<table>
<thead>
<tr>
<th>RES Participants</th>
<th>APES Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Janice, Darlene, Bailey, Brandy</td>
<td>Claims only</td>
</tr>
<tr>
<td>Bailey, Brandy</td>
<td>Claims (emotive)</td>
</tr>
<tr>
<td>April</td>
<td>Claims + scientific evidence</td>
</tr>
<tr>
<td>Brandy, Maya</td>
<td>Claims + topical evidence</td>
</tr>
<tr>
<td>Bailey</td>
<td>Claims + emotive reasoning</td>
</tr>
<tr>
<td>Bailey</td>
<td>Claim + rebuttal</td>
</tr>
<tr>
<td>April</td>
<td>Claims + topical evidence + cognitive reasoning</td>
</tr>
<tr>
<td>April</td>
<td>Claims + topical evidence + cognitive reasoning + rebuttal</td>
</tr>
<tr>
<td>April</td>
<td>Claims + scientific evidence + cognitive reasoning</td>
</tr>
<tr>
<td>Bailey, April</td>
<td>Rebuttal only</td>
</tr>
<tr>
<td>Darlene</td>
<td>Rebuttal, scientific evidence, cognitive reasoning</td>
</tr>
<tr>
<td>Bailey</td>
<td>Scientific evidence only</td>
</tr>
<tr>
<td>Bailey</td>
<td>Scientific evidence + cognitive reasoning</td>
</tr>
<tr>
<td>Brandy</td>
<td>Topical evidence only</td>
</tr>
</tbody>
</table>

4.2.2.1 Use of claims only

Participants in both RES classes approached their use of argumentation in various ways. As found in Table 9, there were instances where participants used only claims and
did not expound on their beliefs. For instance, in a chapter packet relating to volcanic activities, Brandy wrote this response.

**Classwork question:** State whether you agree or disagree and give your rationale for your opinion. Building codes should be held accountable for creating structure codes that can withstand earthquakes.

**Brandy’s response:** I agree because these individuals need to develop a back-up plan (claim).

In the small group discussion, Brandy took charge and wrote the group response based out of a collection of several students’ answers as I noted when she presented this in class.

We agree that the government should have building codes to ensure that all structures are safe from earthquakes (Neil’s claim). The government should make sure that no matter what happens this takes place (Skylar’s claim). The government should always have a back-up plan (Brandy’s claim). Better to be safe than sorry especially in areas where earthquakes have occurred in the past [sic]. Those areas are most prone to earthquakes. And if the government doesn’t take care of it and the earthquake does happen [sic], damage from the earthquake could cause more than the costs to keep it safe.

One example of a statement that would have been coded as evidence in regards to Brandy’s claims would be a historical event that demonstrated the consequences of an ill-prepared government (e.g., Hurricane Katrina). In this way the last few lines in which she explains the consequences of earthquakes could also serve as a form of cognitive reasoning for this type of evidence (Sadler & Zeidler, 2005).

In another example, Brian, an African-American male, read a question from the *Planet in Peril* film discussion questions to Janice, a senior participant, that the group must work on to present in front of the class.

Brian: In your opinion, how might scientists and policymakers prevent the spread of [zoonotic] diseases?

Janice: By watching what they eat.
In the previous passage, an example of a well-supported statement may have involved an example that shows the importance of watching one’s diet from the film. An additional statement that provides an explanation of why Janice thought to use this example – her reasoning – may have also been included.

4.2.2.2 Use of claims and evidence only

Participants also used only claim and evidence. During one classroom event, Maya provided a claim and supporting evidence, but did not provide any reasoning to fully connect the evidence to the claims. One can see this in her answer during small group as she responded to the question of whether the environmentalists in the film were successful in their efforts to protect the animals and surrounding environment. She states to her group, “The fact that they studied them and take pictures (topical evidence), and I guess to just spread the word about their research (topical evidence). That is what I said for that one. And I think it has been successful (claim).”

Additionally, there were two instances in which Maya used evidence related to the topic at hand in the above passage. For the sake of my study, I distinguish between data that is collected from scientific research to support the claim – scientific evidence as defined by McNeill and Pimentel (2010) – with topical evidence, as the participants often used in Mr. J.’s class. This evidence was not wholly scientific, but included relevant information that could only be found in the media or data sources that Mr. J. presented to his class for their use in reconciling different environmental science issues. Other arguments that were constructed relied on the group make-up as found in the next section.
4.2.2.3 Use of reasoning

Participants often missed opportunities to use reasoning as a way to explain their evidence. This occurred for both RES and APES classes. However, I will discuss the APES participants in a later section. When RES students did use reasoning, they predominantly relied on the use of cognitive reasoning as described by Sadler and Zeidler (2005). Their reasoning was characterized by rational and logical thinking – unlike the emotive or intuitive (spiritual) types of reasoning that I included in my model. Four participants, Bailey, Brandy, April, and Maya still used caring in other ways, particularly with claims which will be described in an upcoming section.

Bailey relied on emotive reasoning explicitly once during her presentation. In this instance, her group placed her rationale of lack of caring as an emotive type of reasoning on the whiteboard, though this was asserted as a claim in small group discussion (Please see Figure 11). April was more implicit in her emotive reasoning. This was made apparent in the interviews. One example may be found at the beginning of this section with her quote.

In regards to the use of cognitive reasoning, however, one possible interpretation of these findings is that this may be linked to their disconnection with classroom activities. Another possibility is that the use of cognitive reasoning still had elements of emotive or intuitive reasoning if noting the overall theme of the reasoning being used.

In written work, Mr. J. assigned activities that pointedly referred to the use of reasoning, but no evidence to aid in the support of the claim. For example, in a paper that Maya turned in to Mr. J., statements were presented that asked students to agree or disagree with them and include an explanation. In the statement that I assessed, Maya
adopted a practical approach by using cognitive reasoning when discussing the consequences of growing populations on the environment.

**Argumentation-based statement:** Growing populations do not create social environmental problems in areas where food resources are not limited.

**Maya’s response:** Disagree, because the more people, the more problems [sic]. There’s always going to be somebody or a group of people who is going to do something negative which can cause problems.

In an interview, I asked Maya if she could somehow relate the preceding response with the town hall simulation, which involved altering a natural preserve to benefit the inclusion of more citizens. Maya struggled with connecting this statement to another activity, by saying that it was “probably not” related. Later, she stated, “I think it does, but then it don’t.” After a few seconds, she then stated, “Yeah. I just can't really remember much about how it was built – like how they were building it.”

Although the use of reasoning was sporadic with RES participants, several of these students did find opportunities to use an advanced element of argumentation, the rebuttal.

**4.2.2.4 Use of rebuttal**

McNeill and Pimentel describe a rebuttal in the McNeill and Krajcik model as an advanced form of argumentation (2010). In the town hall simulation, Mr. J. formally integrated the options for students to use rebuttal in arguments for or against the building of the nature group. However, none of the participants in the study used this element of argumentation at the time of the actual simulation. Rebuttal still arose during the *Planet of the Peril* film activity and Town Hall simulation small group discussions for these participants, however. One example involved April in her group. Please see Table 10 for
the discourse analysis portion. For ease of presentation, the discussion that follows the passage will coincide with the line numbers of the passage below.

1. **Katie**: Can environmental and economic priorities be balanced?
2. **Vicki**: I think if this keeps going, I don’t think it’s going to be balanced though.
3. **April**: I think they could. I don’t know. But certain steps are going to have to be made in order to balance it out (**rebuttal**).
4. **Katie**: Like what?
5. **April**: I don’t know. Well, **(starts to read part of the question again to herself) can environmental and economic priorities be balanced?**
6. **Katie**: So, can the importance of the economy and the wealth of the country be equal to the environment and natural resources?
7. **April**: I’m still…
8. **Katie**: I think it should be? But I think it would be really hard to actually try ‘cause… (**All three girls start to excitedly talk at once**).
9. **Katie**: So, do we agree that…
10. **April**: It should be balanced but…
11. **Katie**: Are you saying that it can’t be equal? Like, cause…
12. **April**: I think it could, it just…there’s just measures and steps that have to be taken (**restating rebuttal**).

In line 16, April uses a restating strategy from her original rebuttal to focus on the issue that additional steps should be done to ensure that economic and environmental priorities are balanced, but she is unable at that moment to come up with evidence for her claim (Green & Wallat, 1981). However, in her interview, I asked her if she could expound on this more. She stated, “I guess one step could be making sure that environmentalists talk with people who are responsible for running our economy – the government. I think making sure everyone is communicating should be important.”

Below, the participant Darlene, also used a rebuttal when discussing the prevention of zoonotic diseases (transmission from animal to human) with Brian, an African-American male in her small group with Janice, another participant.

1. **Brian**: Humans are more important to the animals (**claim**).
2. **Darlene**: Because humans are more important than them (**clarification of claim**)?
3. **Brian**: Yes.
5. Darlene: That's wrong (rebuttal), because they [the animals] are part of our ecosystem (evidence) and we need them to survive anywhere, all around (cognitive reasoning).

*Figure 10* The Bailey group presentation board
Table 10

Discourse analysis of April during rebuttal

<table>
<thead>
<tr>
<th>Line number</th>
<th>Message unit</th>
<th>Contextualization cue (CC)</th>
<th>Conversation strategies</th>
<th>Loc. of Know.</th>
<th>Conversation strategies</th>
<th>Loc. of Know.</th>
<th>Argument codes</th>
<th>Interaction units (lines)</th>
<th>Social interaction</th>
<th>Linguistic evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Can environmental and economic priorities be balanced↑</td>
<td>Reading from paper and looking at both April and Vicki alternatively; raised intonation after balanced</td>
<td>Question</td>
<td>Katie</td>
<td>Raising</td>
<td>Katie</td>
<td>NA</td>
<td>1-3</td>
<td>With group</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>2</td>
<td>I think if this keeps going,</td>
<td>Looking at April and Katie</td>
<td>Response</td>
<td>Vicki</td>
<td>Confirming (+)</td>
<td>Vicki</td>
<td>Claim</td>
<td>1-3</td>
<td>With group</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>3</td>
<td>I don’t think it’s going to be balanced, though</td>
<td>Looking at April and Katie</td>
<td>Response</td>
<td>Vicki</td>
<td>Confirming (+)</td>
<td>Vicki</td>
<td>Claim</td>
<td>1-3</td>
<td>With group</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>4</td>
<td>I think they could..</td>
<td>Looking at Katie</td>
<td>Response</td>
<td>April</td>
<td>Confirming (+)</td>
<td>April</td>
<td>Rebuttal</td>
<td>4-7</td>
<td>With group</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>5</td>
<td>I don’t know</td>
<td>Looking at Katie</td>
<td>Response</td>
<td>April</td>
<td>Confirming (-/+</td>
<td>April</td>
<td>Rebuttal</td>
<td>4-7</td>
<td>With group</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>6</td>
<td>But certain steps are going to have to be made in order to balance it out</td>
<td>Looking at Katie</td>
<td>Response</td>
<td>April</td>
<td>Extending</td>
<td>April</td>
<td>Rebuttal</td>
<td>4-7</td>
<td>With group</td>
<td>Ccs and content of message unit</td>
</tr>
</tbody>
</table>
Table 10 - Continued

<table>
<thead>
<tr>
<th>Line number</th>
<th>Message unit</th>
<th>Contextualization cue (CC)</th>
<th>Conversation strategies</th>
<th>Loc. of Know.</th>
<th>Conversation strategies</th>
<th>Loc. of Know.</th>
<th>Argument Codes</th>
<th>Interaction units (lines)</th>
<th>Social interaction</th>
<th>Linguistic evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Like what†</td>
<td>Looking at April; raised intonation at end “what”</td>
<td>Question</td>
<td>April</td>
<td>Clarifying</td>
<td>April</td>
<td>NA</td>
<td>4-7</td>
<td>April</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>8</td>
<td>I don’t know</td>
<td>Looking at paper; flat intonation during unit</td>
<td>Response</td>
<td>April</td>
<td>Clarifying</td>
<td>April</td>
<td>NA</td>
<td>7-10</td>
<td>Katie</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>9</td>
<td>We’ll</td>
<td>Elongated “e” on word; looking down at paper</td>
<td>Response</td>
<td>April</td>
<td>Focusing (Marking)</td>
<td>April</td>
<td>NA</td>
<td>7-10</td>
<td>With Katie</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>10</td>
<td>Can environmental and economic priorities be balanced†</td>
<td>Reading paper</td>
<td>Question</td>
<td>April</td>
<td>Clarifying</td>
<td>April</td>
<td>NA</td>
<td>7-10</td>
<td>Na</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>11</td>
<td>So, can the importance of the economy and the wealth of the country be equal to the environment and natural resources†</td>
<td>Reading paper and looking at April</td>
<td>Question</td>
<td>Katie</td>
<td>Clarifying</td>
<td>Katie</td>
<td>NA</td>
<td>11-13</td>
<td>With April</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>12</td>
<td>I’m still</td>
<td>Reading paper and looking at Katie</td>
<td>Response</td>
<td>April</td>
<td>Clarifying</td>
<td>Katie</td>
<td>NA</td>
<td>11-13</td>
<td>With Katie</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>Line number</td>
<td>Message unit</td>
<td>Contextualization cue (CC)</td>
<td>Conversation strategies</td>
<td>Loc. of Know.</td>
<td>Conversation strategies</td>
<td>Loc. of Know.</td>
<td>Argument codes</td>
<td>Interaction units(lines)</td>
<td>Social interaction</td>
<td>Social interaction</td>
</tr>
<tr>
<td>-------------</td>
<td>------------------------------------------------------------------------------</td>
<td>----------------------------</td>
<td>--------------------------</td>
<td>---------------</td>
<td>-------------------------</td>
<td>---------------</td>
<td>-----------------</td>
<td>------------------------</td>
<td>--------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>13</td>
<td>I think it should be↑</td>
<td>Stress on “should” raised intonation at end of “be”</td>
<td>Response</td>
<td>Katie</td>
<td>Confirming (+)</td>
<td>Katie</td>
<td>Claim</td>
<td>11-13</td>
<td>With April/group</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>14</td>
<td>But I think it would be really hard to actually try cause</td>
<td>Talking fast (inaudible after this unit); looking at April and Vicki</td>
<td>Response</td>
<td>Katie</td>
<td>Confirming (+)</td>
<td>Katie</td>
<td>Claim</td>
<td>11-13</td>
<td>With April/group</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>15</td>
<td>So do we agree that</td>
<td>Sounds like beginning of question; looking at both April and Vicki</td>
<td>Question (?)</td>
<td>Katie</td>
<td>Focusing</td>
<td>Katie</td>
<td>NA</td>
<td>15-21</td>
<td>With group</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>16</td>
<td>It should be balanced but</td>
<td>Looking at Vicki; various intonations</td>
<td>Response</td>
<td>April</td>
<td>Confirming (+)</td>
<td>April</td>
<td>Rebuttal</td>
<td>15-21</td>
<td>With group</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>17</td>
<td>Are you saying that…it can’t be equal↑</td>
<td>Looking at April</td>
<td>Question</td>
<td>April</td>
<td>Clarifying</td>
<td>April</td>
<td>NA</td>
<td>15-21</td>
<td>To April</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>18</td>
<td>Like, cause</td>
<td>Looking at April</td>
<td>Response</td>
<td>Katie</td>
<td>Raising</td>
<td>Katie</td>
<td>NA</td>
<td>15-21</td>
<td>To April</td>
<td>Ccs and content of message unit</td>
</tr>
</tbody>
</table>
Table 10 – Continued

<table>
<thead>
<tr>
<th>Line number</th>
<th>Message unit</th>
<th>Contextualization cue (CC)</th>
<th>Conversation strategies</th>
<th>Loc of Know.</th>
<th>Conversation strategies</th>
<th>Loc of Know.</th>
<th>Argument codes</th>
<th>Interaction units</th>
<th>Social interaction</th>
<th>Linguistic evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>I think it could</td>
<td>Sress on “could” looking at Katie and Vicki</td>
<td>Response</td>
<td>April</td>
<td>Restating</td>
<td>April</td>
<td>Rebuttal</td>
<td>Lines 15</td>
<td>With Katie</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>20</td>
<td>it just</td>
<td>Sress on “could” looking at Katie and Vicki</td>
<td>Response</td>
<td>April</td>
<td>Restating</td>
<td>April</td>
<td>Rebuttal</td>
<td>Lines 15</td>
<td>With Katie</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>21</td>
<td>there’s just measures and steps that have to be taken</td>
<td>Sress on “could” looking at Katie and Vicki</td>
<td>Response</td>
<td>April</td>
<td>Restating</td>
<td>April</td>
<td>Rebuttal</td>
<td>Lines 15</td>
<td>With Katie</td>
<td>Ccs and content of message unit</td>
</tr>
</tbody>
</table>

*Note. Loc. of Know. is the location of knowledge found in the message unit.*
Darlene’s argument followed the McNeill & Krajcik model, where she clearly rebutted Brian’s claim and provided scientific evidence and cognitive reasoning succinctly to support her rebuttal (2012). Although Brian chose to ignore her after this point, such a simple statement reflects how an argument in a simple form may still convey its appropriate meaning.

In her role as county commissioner for the town hall simulation, Bailey also utilized rebuttal in an argument. Although Bailey’s group did not actually have to construct and present their arguments for the town hall simulations, argumentation-based discussion arose while the group prepared for the simulation the next day. During this time, Bailey wanted to ensure that the group was prepared for the arguments presented by the two main groups, the Chamber of Commerce and the Friends of Nature, the following day. In the passage below, Adam, her friend from her original group who was also placed with the county commissioners, showed her a map of the proposed plan that included the proposed renovations to the nature preserve. The analysis for this exchange may be found in Table 11. For ease of presentation, the discussion that follows Table 11 will use the line numbers from the passage below.

1. **Bailey**: All the little additions of this highway was unnecessary (claim).
2. At the bottom? Talking about that little thing? How they made the highway over there. They, they could have kept the little…what was that again? The roads…the roads or something…
3. **Adam**: Yeah.
4. **Bailey**: They could have kept that.
5. **Students are talking over each other. Someone says, “Make it look nice”**
6. **Put some money into it.**
7. **Bailey**: (looking and sounding insistent) They didn’t need the highway, though (claim). It’s suppose to be a campground site. What campgrounds’ that you know that got a highway (personal evidence)?
8. **Adam**: But that bring more money and revenue to the area, putting a highway… (Adam’s voice gets louder when he says this) (rebuttal)
14. **Bailey**: Yeah, right. *(She says this in a sarcastic and disbelieving tone. Adam starts to talk and she calmly cuts him off).*

15. The highway was unnecessary. *(rebuttal)*

16. **Adam**: And you put the highway in, you gotta get off. You get gas *(personal evidence)*. Where you gonna go *(cognitive reasoning)*?

17. **Bailey**: That’s true. People will buy some if that’s there.

Although Bailey eventually conceded to Adam’s reasoning for the inclusion of an additional highway in line 19, she first used extending strategies beginning in line 1 of this excerpt. Extending strategies involve the individual adding new information to a current or previous message unit (Green & Wallat, 1981). She then used restating strategies in lines 9 and 16, respectively, to emphasize her claim and rebuttal that it was not necessary in the construction of the park (Green & Wallat, 1981). Bailey also counted on the use of personal evidence to support her rebuttal beginning in line 10, appealing to the rest of the group to use their own personal knowledge and experiences to understand the logic behind her claim. However, she did not provide any other additional information. Adam responded by supplying his own personal evidence and cognitive reasoning to support his rebuttal beginning in line 17 as he discussed one positive consequence of a highway. This eventually led to Bailey’s assent to his rebuttal.

4.2.2.5 **Elements of group-constructed arguments**

4.2.2.5.1 **Bailey, Xavier, and Adam.**

It was not too long before I noticed the dynamics of two groups in this study. One of my participants, Bailey, typically sat in a group with three African-American boys, Adam, Xavier, and Jim. Once in a while, another young Vietnamese student with a developing use of the English language joined them but remained silent, perhaps due to his challenges with English. The other tablemates’ conversations were lively and
expressive. When they were not discussing relevant class work, they mainly talked of sports: Bailey was a track runner for Riverwest and at the time I was collecting data, was waiting to hear back from a Midwestern school about a potential scholarship offer.

Xavier and Joe were football players, and Adam played basketball for Riverwest. In their conversations, they also gossiped about other students and teachers in the school, joked and teased each other (even in the middle of arguments), lamented together, and overall seemed to enjoy each other’s company. In terms of argumentation, I noticed the respect they showed each other as they each contributed their own perspectives in their arguments. At the same time, they seemed to feel free voicing their viewpoints. This manifested into constructed arguments that clearly stemmed from in-depth group discussions. Bailey and her friends often offered different elements to their arguments that led to a fruitful and engaging discussion. Here is one example of the group volunteering different argumentative components. In this passage, Bailey reads a question from the assigned *Planet in Peril* film questions.

1. **Bailey**: Can environmental economic priorities be balanced?
2. **Adam**: Yes, they can *(claim)*.
3. **Xavier**: Yes they can, we just need to stop consuming…we have to care more about this earth *(claim)*.
4. **Bailey**: How about saying... organic eating *(scientific evidence)*?

In a class presentation of their answers, Bailey continued to connect Adam’s argumentative elements with her own when answering question number 4. Adam spoke before Bailey and answered number 3 of the *Planet in Peril* questions. He states, “With the oil in Nigeria *(topical evidence)*, and, um, how we don’t have…how we have less of it. It’s going to become more expensive in gas *(cognitive reasoning)*.”
Table 11
Discourse analysis of Bailey's rebuttal during town hall

<table>
<thead>
<tr>
<th>Line number</th>
<th>Message unit</th>
<th>Contextualization cue (CC)</th>
<th>Conversation strategies</th>
<th>Loc. of Know.</th>
<th>Conversation strategies</th>
<th>Loc of Know.</th>
<th>Argument codes</th>
<th>Interaction units (lines)</th>
<th>Social interaction</th>
<th>Linguistic evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>All the little additions of this highway was unnecessary</td>
<td>Looking at map and at Adam and Steve across the table; talking low with flat intonation</td>
<td>Response</td>
<td>Bailey</td>
<td>Focusing</td>
<td>Bailey</td>
<td>Claim</td>
<td>Beginning here</td>
<td>With group (Steve and Adam mainly)</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>2</td>
<td>At the bottom†</td>
<td>Looking at map and at Adam and Steve across the table; talking low with flat intonation</td>
<td>Question</td>
<td>Bailey</td>
<td>Extending</td>
<td>Bailey</td>
<td>Claim</td>
<td>2-7</td>
<td>With group (Steve and Adam mainly)</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>3</td>
<td>Talking about that little thing† How they made the highway over there†</td>
<td>Looking at map and at Adam and Steve across the table; talking low with flat intonation</td>
<td>Question</td>
<td>Bailey</td>
<td>Extending</td>
<td>Bailey</td>
<td>Claim</td>
<td>2-7</td>
<td>With group (Steve and Adam mainly)</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>4</td>
<td>They…they could have kept the little</td>
<td>Looking at map and at Adam and Steve across the table; talking low with flat intonation</td>
<td>Response</td>
<td>Bailey</td>
<td>Extending</td>
<td>Bailey</td>
<td>Claim</td>
<td>2-7</td>
<td>With group (Steve and Adam mainly)</td>
<td>Ccs and content of message unit</td>
</tr>
</tbody>
</table>
Table 11 – Continued

<table>
<thead>
<tr>
<th>Line number</th>
<th>Message unit</th>
<th>Contextualization cue (CC)</th>
<th>Conversation strategies</th>
<th>Loc. of Know.</th>
<th>Conversation strategies</th>
<th>Loc. of Know.</th>
<th>Argument codes</th>
<th>Interaction units (lines)</th>
<th>Social interaction</th>
<th>Linguistic evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>What was that again↑</td>
<td>Looking at map and at Adam and Steve across the table; talking low with flat intonation</td>
<td>Question</td>
<td>Bailey</td>
<td>Extending</td>
<td>Bailey</td>
<td>Claim</td>
<td>2-7</td>
<td>With group (Steve and Adam mainly)</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>6</td>
<td>The roads…the roads or something</td>
<td>Looking at map and at Adam and Steve across the table; talking low with flat intonation</td>
<td>Response</td>
<td>Bailey</td>
<td>Extending</td>
<td>Bailey</td>
<td>Claim</td>
<td>2-7</td>
<td>With group (Steve and Adam mainly)</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>7</td>
<td>Yeah</td>
<td>Looking at map; flat intonation with “yeah”</td>
<td>Response</td>
<td>Adam</td>
<td>Confirming (+)</td>
<td>Adam</td>
<td>Na</td>
<td>2-7</td>
<td>With Bailey</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>8</td>
<td>They could have kept that</td>
<td>Looking at Adam; flat intonation</td>
<td>Response</td>
<td>Bailey</td>
<td>Restating</td>
<td>Bailey</td>
<td>Claim</td>
<td>7-8</td>
<td>With group (Adam mainly)</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>9</td>
<td>They didn’t need the highway, though</td>
<td>Intonation of tone; looking at her group members and mainly adam</td>
<td>Response</td>
<td>Bailey</td>
<td>Restating</td>
<td>Bailey</td>
<td>Claim/Rebuttal? (inaudible)</td>
<td>Beginning again</td>
<td>With group</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>10</td>
<td>It’s suppose to be campgrounds</td>
<td>Intonation of tone; looking at her group members and mainly adam</td>
<td>Response</td>
<td>Bailey</td>
<td>Extending</td>
<td>Bailey</td>
<td>NA</td>
<td>NA</td>
<td>With group</td>
<td>Ccs and content of message unit</td>
</tr>
</tbody>
</table>
### Table 11 – Continued

<table>
<thead>
<tr>
<th>Line number</th>
<th>Message unit</th>
<th>Contextualization cue (CC)</th>
<th>Conversation strategies</th>
<th>Loc. of Know.</th>
<th>Conversation strategies</th>
<th>Loc. of Know.</th>
<th>Argument codes</th>
<th>Interaction units (lines)</th>
<th>Social interaction</th>
<th>Linguistic evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>what campgrounds’ that you know that got a highway↑</td>
<td>Various intonations in tone; raised at end of “highway”, raised pitch; stress on “you”; looking at group members</td>
<td>Question</td>
<td>Bailey</td>
<td>Raising</td>
<td>Bailey</td>
<td>Personal evidence</td>
<td>Na</td>
<td>Group</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>12</td>
<td>But that bring more money and revenue to the area.</td>
<td>Raised pitch, stress on “area”/ looking at Bailey</td>
<td>Response</td>
<td>Adam</td>
<td>Raising</td>
<td>Adam</td>
<td>Rebuttal</td>
<td>11-13</td>
<td>Bailey</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>13</td>
<td>putting a highway</td>
<td>Raised pitch, stress on “area”/ looking at Bailey</td>
<td>Response</td>
<td>Adam</td>
<td>Raising</td>
<td>Adam</td>
<td>Rebuttal</td>
<td>11-13</td>
<td>Bailey</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>14</td>
<td>Yeah right</td>
<td>Sharp tone; looking away from Adam</td>
<td>Response</td>
<td>Bailey</td>
<td>Confirming (-)</td>
<td>Bailey</td>
<td>Rebuttal</td>
<td>14-19</td>
<td>Adam</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>15</td>
<td>The highway was unnecessary</td>
<td>Bailey</td>
<td>Response</td>
<td>Bailey</td>
<td>Restating</td>
<td>Rebuttal</td>
<td>14-19</td>
<td>Adam</td>
<td>Ccs and content of message unit</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>And you put the highway in, you gotta get off.</td>
<td>Adam</td>
<td>Response</td>
<td>Adam</td>
<td>Raisings</td>
<td></td>
<td>Personal evidence</td>
<td>14-10</td>
<td>Bailey</td>
<td>Ccs and content of message unit</td>
</tr>
</tbody>
</table>
Table 11 – Continued

<table>
<thead>
<tr>
<th>Line number</th>
<th>Message unit</th>
<th>Contextualization cue (CC)</th>
<th>Conversation strategies</th>
<th>Loc. of Know.</th>
<th>Conversation strategies</th>
<th>Loc. of Know.</th>
<th>Argument codes</th>
<th>Interaction units (lines)</th>
<th>Social interaction</th>
<th>Linguistic evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>You get gas</td>
<td>Adam looking at Bailey</td>
<td>Response</td>
<td>Adam</td>
<td>Extending</td>
<td>Adam</td>
<td>Cognitive reasoning</td>
<td>14-19</td>
<td>Adam and Bailey</td>
<td>CCs and content of message unit</td>
</tr>
<tr>
<td>18</td>
<td>Where you gonna go↑</td>
<td>Adam</td>
<td>Question</td>
<td>Adam</td>
<td>Extending</td>
<td>Adam</td>
<td>Cognitive reasoning</td>
<td>14-19</td>
<td>Adam and Bailey</td>
<td>CCs and content of message unit</td>
</tr>
<tr>
<td>19</td>
<td>That’s true. People will buy some if that’s there</td>
<td>Bailey</td>
<td>Response</td>
<td>Bailey</td>
<td>Confirming (+)</td>
<td>Bailey</td>
<td>NA</td>
<td>14-19</td>
<td>Adam and Bailey</td>
<td>CCs and content of message unit</td>
</tr>
</tbody>
</table>

*Note. Loc. of Know. is the location of knowledge found in the message unit.*
Bailey then states, “For number 4, how do the issues and problems relate to you? Well, we said that eventually it does…well, right now it doesn’t affect us. Well, that's what he just said.” As noted, Bailey attempts to connect her answer with Adam’s previous answer.

Another interesting characteristic of this group was how the members voiced their perspectives. For instance, Bailey’s group disagreements were peppered with respect as determined by their contextualization cues. Bailey, a petite girl with a big smile, usually laced her statements – including her arguments – with a smile or a chuckle. The other students at the table quieted when she spoke giving her many opportunities to place herself as the locator of knowledge – the central producer of information – as determined by the message units I examined during analysis (Bloome et al., 2005). Xavier, a very straightforward and intelligent senior, typically chose a stance that involved him leaning toward Bailey and Adam, who sat across from him, with his arms under the table. The passage below is one example that depicts the group discussing the role of environmentalists in the *Planet in Peril* film. In this exchange, the group discusses whether the film environmentalists have been successful in their efforts to promote proper care for the environment. Table 12 provides the discourse analysis for this segment. The line numbers in Table 12 do not coincide with the line numbers in the passage directly below. For ease of presentation, the discussion following these tables will coincide with the passage below.

1. **Adam**: Do you think their role is successful?
2. **Xavier**: No!
3. **Bailey**: Whatchu’ say?
4. **Adam**: Is it successful?
5. **Xavier**: Somewhat. Somewhat successful (claim).
6. **Bailey**: I…I…I…they not! (*Bailey is strong in her response. But*)
7. she is still smiling hard at Xavier (rebuttal).
8. Xavier: So they didn’t stop any people? They didn’t recover over 10 million dollars in elephant tusks (topical evidence)?
9. Adam (He is looking down): I ‘on know, I ‘on know…
10. Bailey: Yeah, the elephants… (agreeing to claim)
11. Adam: But they weren’t catching a tiger (rebuttal).
13. Adam: They [the tigers] gonna be gone (extension of rebuttal).
14. Xavier: They play a small role but they can’t…they can’t do it all (claim).
15. Bailey: ‘Cause they’re ain’t enough people that care about the environment (extending claim).

In the preceding passage, the group utilized several elements of an argument. Xavier used claims in lines 5 and 13. Bailey used advanced argumentation by implementing a rebuttal to Xavier’s claim in line 6 and an extending strategy with Xavier’s claim in line 17 (McNeill & Pimentel, 2010; Wallat & Green, 1981). Xavier provided Bailey with topical evidence which led to her agreeing with his claim. However, Adam utilized a rebuttal and an extending strategy on that rebuttal in lines 12 and 15, respectively (Green & Wallat, 1981).

4.2.2.5.2 April, Vicki, and Katie.

The other group of significant interest in Mr. J.’s classroom consisted of the study participant April, a junior, along with Katie and Vicki. Vicki is a Vietnamese student with a strong accent, and Katie is a White female student. Collectively, their exchanges were dynamic and interwoven with respect. Often, April, Katie, and Vicki, would become animated, finishing each others’ arguments and laughing together. Consequently, their arguments were also group-constructed in very clear and distinct ways. Below is an exchange from one of their discussions based on the Planet in Peril film.
<table>
<thead>
<tr>
<th>Line number</th>
<th>Message unit</th>
<th>Contextualization cue (CC)</th>
<th>Conversation strategies</th>
<th>Loc. of Know.</th>
<th>Conversation strategies</th>
<th>Loc. of Know.</th>
<th>Argument codes</th>
<th>Interaction units (lines)</th>
<th>Social interaction</th>
<th>Linguistic evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Do you too think their role is successful↑</td>
<td>Reading from paper; looking at Bailey, and Xavier; raised intonation after successful</td>
<td>Question</td>
<td>Adam</td>
<td>Raising</td>
<td>Adam</td>
<td>NA</td>
<td>Beginning</td>
<td>With group</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>2</td>
<td>No</td>
<td>Raised pitch; elevated tone; stress on the “no”; looking across table at Adam and Bailey</td>
<td>Response</td>
<td>Xavier</td>
<td>Confirming -</td>
<td>Xavier</td>
<td>Claim</td>
<td>1-2</td>
<td>With Adam</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>3</td>
<td>Whatchu say↑</td>
<td>Bailey looks at Adam; eyes squinted and mouth open; raised intonation at end of say indicating question.</td>
<td>Question</td>
<td>Adam</td>
<td>Clarifying</td>
<td>Adam</td>
<td>NA</td>
<td>3-4</td>
<td>With Adam</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>4</td>
<td>Are they successful↑</td>
<td>Looking down at paper reading question; looks at Bailey afterward; raised intonation at end of successful</td>
<td>Question</td>
<td>Adam</td>
<td>Clarifying</td>
<td>Adam</td>
<td>NA</td>
<td>3-4</td>
<td>With Bailey</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>Line number</td>
<td>Message unit</td>
<td>Contextualization cue (CC)</td>
<td>Conversational strategies</td>
<td>Loc. of Know.</td>
<td>Conversation strategies</td>
<td>Loc. of Know</td>
<td>Argument codes</td>
<td>Interaction units (lines)</td>
<td>Social interaction</td>
<td>Linguistic evidence</td>
</tr>
<tr>
<td>-------------</td>
<td>--------------</td>
<td>----------------------------</td>
<td>---------------------------</td>
<td>--------------</td>
<td>------------------------</td>
<td>--------------</td>
<td>----------------</td>
<td>--------------------------</td>
<td>------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>5</td>
<td>Somewhat</td>
<td>Looking Bailey and Adam and leaning towards them</td>
<td>Response</td>
<td>Xavier</td>
<td>Confirming (+)</td>
<td>Xavier</td>
<td>Claim</td>
<td>4-6</td>
<td>Adam and the rest of the group</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>6</td>
<td>somewhat successful</td>
<td>Pause after successful; leaning toward Adam and Bailey with hands under table.</td>
<td>Response</td>
<td>Xavier</td>
<td>Restating</td>
<td>Xavier</td>
<td>Claim</td>
<td>4-6</td>
<td>Adam and the rest of group</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>7</td>
<td>I…I…I….</td>
<td>Looking at Xavier with smile</td>
<td>Response</td>
<td>Bailey</td>
<td>Restating</td>
<td>Bailey</td>
<td>Beginning of rebuttal</td>
<td>6-9</td>
<td>Bailey and Xavier</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>8</td>
<td>They not</td>
<td>Raised intonation through out; Stress on both words, looking at Xavier and smiling</td>
<td>Response</td>
<td>Bailey</td>
<td>Confirming (-)</td>
<td>Bailey</td>
<td>Rebuttal</td>
<td>6-9</td>
<td>Bailey and Xavier</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>Line number</td>
<td>Message unit</td>
<td>Contextualization cue (CC)</td>
<td>Conversatio n strategies</td>
<td>Loc. of Know.</td>
<td>Conversation strategies</td>
<td>Loc. of Know.</td>
<td>Argument codes</td>
<td>Interaction units (lines)</td>
<td>Social interaction</td>
<td>Linguistic evidence</td>
</tr>
<tr>
<td>-------------</td>
<td>--------------</td>
<td>-----------------------------</td>
<td>---------------------------</td>
<td>---------------</td>
<td>------------------------</td>
<td>---------------</td>
<td>----------------</td>
<td>------------------------</td>
<td>------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>9</td>
<td>So they didn’t stop any people? They didn’t recover over 10 million dollars in elephant tusks?</td>
<td>Raised intonation at people and tusks; leaning towards Bailey and staring at her with hands under table; looks earnest; talking quickly in message unit to signify complete message</td>
<td>Question</td>
<td>Xavier</td>
<td>Raising</td>
<td>Extending</td>
<td>Xavier</td>
<td>Rebuttal</td>
<td>6-9</td>
<td>With Bailey</td>
</tr>
<tr>
<td>10</td>
<td>I ‘on know, I ‘on know</td>
<td>Adam looking down at paper and shaking head</td>
<td>Response</td>
<td>Adam</td>
<td>Restating</td>
<td>Adam</td>
<td>NA</td>
<td>NA</td>
<td>With group</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>11</td>
<td>Yeah, the elephants</td>
<td>Words quickly together; nods head at Xavier</td>
<td>Response</td>
<td>Bailey</td>
<td>Restating</td>
<td>Bailey</td>
<td>NA</td>
<td>NA</td>
<td>With Xavier</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>12</td>
<td>But they weren’t catching a tiger</td>
<td>Looking at Xavier with eyebrows raised; voice is elevated compared to normal</td>
<td>Response</td>
<td>Adam</td>
<td>Raising</td>
<td>Adam</td>
<td>Rebuttal</td>
<td>NA</td>
<td>With Xavier</td>
<td>Ccs and content of message unit</td>
</tr>
</tbody>
</table>
Table 12 – Continued

<table>
<thead>
<tr>
<th>Line number</th>
<th>Message unit</th>
<th>Contextualization cue (CC)</th>
<th>Conversation strategies</th>
<th>Loc. of Know.</th>
<th>Conversation strategies</th>
<th>Loc. of Know.</th>
<th>Argument codes</th>
<th>Interaction units (lines)</th>
<th>Social interaction</th>
<th>Linguistic evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>They tryin’ though. Give them some credit</td>
<td>Looking at Adam; leaning towards him; various intonations</td>
<td>Response</td>
<td>Xavier</td>
<td>Raising</td>
<td>Xavier</td>
<td>Rebuttal</td>
<td>12-16</td>
<td>With Group</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>14</td>
<td>They gonna be gone</td>
<td>Looking down at table and at Xavier. Flat intonation of speech</td>
<td>Response</td>
<td>Adam</td>
<td>Extending</td>
<td>Adam</td>
<td>Rebuttal</td>
<td>12-16</td>
<td>With Group</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>15</td>
<td>They play a small role but they can’t</td>
<td>Various intonations; looking at Bailey and Adam; pause after “can’t”</td>
<td>Response</td>
<td>Xavier</td>
<td>Restating</td>
<td>Xavier</td>
<td>Claim</td>
<td>12-16</td>
<td>With Group</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>16</td>
<td>Can’t do it all</td>
<td>Pause at end of all indicating end of message unit; looking at Bailey and Adam</td>
<td>Response</td>
<td>Xavier</td>
<td>Restating/Extending</td>
<td>Xavier</td>
<td>Claim</td>
<td>12-16</td>
<td>With Group</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>17</td>
<td>Cause they’re ain’t enough people</td>
<td>Looking at Xavier</td>
<td>Response</td>
<td>Bailey</td>
<td>Restating</td>
<td>Bailey</td>
<td>Claim</td>
<td>16-18</td>
<td>With group</td>
<td>Ccs and content of message units</td>
</tr>
<tr>
<td>18</td>
<td>that care about the environment</td>
<td>Looking at Xavier</td>
<td>Response</td>
<td>Bailey</td>
<td>Extending</td>
<td>Bailey</td>
<td>Claim</td>
<td>16-18</td>
<td>With group</td>
<td>Ccs and content of message units</td>
</tr>
</tbody>
</table>

*Note.* Loc. of Know. is the location of knowledge found in the message unit.
1. April: Do you think [the environmentalists’] efforts are… successful, though?
2. Vicki: Ummm…
3. April: I think, yes. In some places (claim).
4. Vicki: At least like, they like, at least they like… they know how to, I don’t
5. know how to explain this. Like at least like a little bit…
6. Katie: They’re doing something (claim).
8. Katie: They need examples of why they are successful.
9. Long pause as girls read their notes.
10. Katie: Let’s see…
11. Vicki: (inaudible due to strong accent)…so they are helping it. Like, at least
12. some of it.
13. Katie: Yeah. Polar bears? And the sharks? They have to help with shark
14. finning (scientific/topical evidence).
15. Vicki: The gorillas (topical evidence)?
16. April: They also tried to stop poaching and hunting of the sharks and the other
17. stuff we learned about in the video (topical evidence).
18. Katie: (Katie is writing down) The tigers, and the elephants...
19. April: Yeah.
20. Katie: So there’s stopping poachers. And they’re trying to make it stop
21. (Katie is writing this down).
22. April: Or reduce the amount of poachers.
23. Katie: Yeah.

Below is another example of the students in April’s group each contributing either a
claim, a type of evidence, and reasoning in this argumentation-based activity.

1. Vicki: I think…like, I think the animal that I would save is the polar bear,
2. because I think they are really low right now (claim).
3. Katie: Yeah. It was like, 50% in, like, four years, or something, right?
4. (scientific evidence)...
5. Vicki: And the ice is melting right now (scientific evidence), so it’s affected a
6. lot (cognitive reasoning).
7. Katie: What do you think, April?
8. April: Well, because ice glaciers are melting at a faster rate (scientific
evidence) and how they create flooding (scientific evidence), it will affect us
9. over here. ‘Cause, eventually, stuff that affects some countries could affect
10. other countries (cognitive reasoning).

In her interview, I asked April how the unique dynamics of her small group
(e.g., Vicki as a second language learner, understanding different opinions) affected the
group construction of arguments.
April: The fact that other people will have different opinions can maybe help me to think a little differently. Like, it could change my perspective on things or add something that I didn’t learn or think. But then with the people from different backgrounds or there were… I just try and encourage them to like add something. What do you think? What do you want to say? Because if it can make sense to me, it can make sense to them too.

April’s contextualization cues seemed to support the feelings described above. In class, she immediately volunteered to write down the answers and position statements for the group in all argumentation-based activities, and waited patiently for others to speak. She often helped Vicki (along with Katie) when Vicki struggled to find the right words to explain her position. April’s respect for others also translated into her arguments which will be explored in the next section.

4.2.2.6 Explicit and implicit use of caring trait

Four participants – April, Bailey, Brandy, and Maya – showed elements of caring in their use of claims. Such use was either explicitly made known or permeated the theme of the argument itself. This fell in line with my initial proposed study model which implements one significant aspect of Black feminist epistemology, caring, as an important tenet in its framework (Collins, 2000). April, as evident in the quote in the beginning of this section, constructed her claims and evidence in class using linguistic evidence that indicated her respect for the environment and our role as citizens in protecting it. Please see the quote below.

Because, I don’t know, the environment is, like, everything. Because that’s where we live. And, like, the whole thing where they’re trying to move the park is unnecessary and I just thought, ‘They’re just messing with nature for no reason; when it could have just stayed the same. Just adding more pollution and all this other stuff that we don’t need.’
Linguistic evidence is described in Chapter 3 incorporates both the content and contextualization cues of a message unit (Bloome et al., 2005; Green & Wallat, 1981). April implicitly made her intentions of caring known by way of her intonations which fluctuated when discussing certain environmental topics, such as those relating to our complex ecosystem, indicating excitement (Bloome et al., 2005). As viewed above, she emphasized her points by stressing certain words such as “live”. She also used restating strategies to emphasize her points (Green & Wallat, 1981). She confirmed this in her interview, indicating the importance of earth in this short response. “Because, well, here with the environmental things that we had. I just think that it doesn’t affect me, just me, I just think that it affects everybody because we are all a part of the same world.”

However, Bailey, Brandy, and Maya were more explicit overall in their use of caring throughout their arguments in the classroom and/or during the interviews, emphasizing the lack of caring in arguments. Maya added a caring component in her interview by stating, “But there's other people that just might not think [animals] are important” when asked about the Planet in Peril film activity. Although she does not use the word care or caring in her statement, the phrase “might not think [animals] are important” clearly has a caring component that is more ubiquitous than April’s statements. For this same assignment, Bailey emphasized how individuals do not care about the environment enough in the following passage while talking to her group mates.

1. Adam: What challenges do you think you would face?
2. Bailey: A lot of people, they just don’t care. They don't notice what's going on down there.
3. Xavier: Talk more about it at schools.
4. Adam: We get the youth involved.
5. Bailey: You got to get people to actually care about this.
Revisiting the previous discussion in Bailey’s group, she emphasizes the lack of *caring* theme by extending Xavier’s claim as a way to emphasize her point (Wallat & Green, 1981).

11. Adam: But they weren’t catching a tiger (*rebuttal*).
12. Xavier: But they tryin’ though. Give them some credit (*rebuttal*).
13. Adam: They [the tigers] going to be gone (*extension of rebuttal*).
14. Xavier: They play a small role but they can’t…they can’t do it all (*claim*).
15. Bailey: ‘Cause they’re ain’t enough people that care about the environment (*extending claim*).

In another discussion, Bailey and her tablemates discussed the cost of organic vegetables. Although Bailey used cognitive reasoning as a contribution, connecting this rational point with evidence (from a previous environmental science teacher in elementary school), emote a sense of *caring* for African-Americans and Mexicans in an implicit manner. Her use of the word “nobody” is specifically directed to the groups mentioned in her comment, providing a more personal connotation to the statement since she considered herself African-American as well.

We were talking about that [organic vegetables]. She was basically saying how African-Americans, Mexicans can’t really afford stuff like that (*topic evidence*). That’s why they buy, like, the regular stuff. Don’t nobody wanna buy organic stuff because it costs too much (*cognitive reasoning*

Bailey’s own lived experiences, being a daughter of an environmentally conscious single mom afforded her attendance to a local environmental science school from ages 5-10. I asked her about this experience and how it relates to the topics she is learning presently in environmental science class.

I went to environmental school in middle school and elementary.
And, like, we just would talk about stuff like that [lack of respect for the environment]. And I just feel like there’s not enough people that care about the environment or actually think about being an environmentalist and stuff like that.
Bailey’s lived experiences will be further discussed, as well as the other participants, in section 4.3.

In this last example, Brandy evaluated the arguments of several interest groups in the town hall simulation as a concerned citizen. Brandy discussed the lack of caring displayed by the Chamber of Commerce during the RES town hall simulations in her interview. Her disgust with this group of students helped sway her decision on the construction of a lumber mill and other venues in a nature preserve.

They [Chamber of Commerce] were just like more focused on bringing in money and they didn’t seem to care really about the people that were in the neighborhood. They didn’t care. They just wanted money, money…they were money hungry. But, um, they didn’t really touch base on how the people would be affected or anything like that.

In the above passage, Brandy states the word “care” in connection with people, which is different than the foci of the other participants. To her, the environment constitutes more than animals and nature, but the residents themselves.

4.2.2.7 Evaluating arguments: evidence of lived experiences and the economy

Evidence of the evaluation of arguments for the RES participants arose during the town hall simulations where various groups listened to each others’ claims regarding the construction of a mill and campgrounds in a nature preserve. I took time to specifically observe Darlene and Bailey, who were chosen by Mr. J. among others to be county commissioners, the official decision-makers of the groups.

Although Darlene and Bailey were county commissioners in separate RES classes, each took the lead in encouraging members of the group to prepare for the town hall simulation by coming up with either questions (Darlene’s idea) or by listing the pros and cons for the new construction from the perspective of the Friends of Nature and
Chamber of Commerce (Bailey). Bailey’s comments are presented in the following passage.

1. **Bailey**: So if you could write the pros and cons of each, of, um, Friends of Nature…and…damn (*under her breath*), what’s this one called? (*gesturing toward the group of students representing the Chamber of Commerce and asking Adam*)
2. **Adam**: I don’t even know…the Chamber. Isn’t that the Chamber?
3. **Katie**: I think so. They’re for the plan.
4. **Adam**: I be forgetting, I gotta write that down (*laughing*).
5. **Katie**: And Friends of Nature doesn’t want the plan.
6. **Bailey**: Yeah (*voice trails off*)…so we gotta think about…why would they want the plan?

Bailey seemed to also incorporate her own lived experiences while evaluating these arguments which will be further explored in section 4.3. In the section below, however, she used memories of her time in an environmental science school in order to understand the pros of maintaining a nature park along with her lived experiences of the city life.

1. **Bailey**: It’s good *and* bad opportunities. Yeah, I mean it *is* job opportunities for the…if you build the park?
2. **Katie**: Yeah, but then it’s also like, it’s like…who’s it going to benefit?
3. **Bailey**: Yeah.
4. **Bailey** talks at the same time as Adam and it is inaudible.
5. **Bailey**: Yeah, ‘cause…I don’t know about, like, if I could actually work out there. I mean I went to environmental school when I was in Montessori *and* elementary school. I mean, I *liked* it, but I wouldn’t want to be there every day or anything as a *job*.

In her evaluation of arguments, Bailey seemed particularly skeptical of the Friends of Nature position. Upon asking her about these classroom observations in her interview, she responded:

It was just so much land. I mean, I know that, uh, it was the animals that everybody was concerned about. But I just, I don’t know, I couldn’t find any reason for why they wanted to keep it. If it was, like, in no use. Like, it was just…I didn’t find a good reason for why it should have it there. But then I was, like, the
pollution and all of that…I was, like, they were really creating a lot of it. I feel like they didn't have to take up all of that. So, it was hard to make sense of it.

In her explanation, Bailey also commented on the lack of reasoning evident in the Friends of Nature group that partially led to her ambivalence when deciding the fate of the town’s nature preserve. As shown, Bailey approached the view of the nature preserve from a more pragmatic standpoint where she viewed the untouched nature park as a waste if it could not be used for any economic benefits. However, Bailey asked only one question on the day of the town hall simulation and it was directed to the Chamber of Commerce during the day of the town hall. This question related to the trees that would be removed in order to construct new land, “I have a question for everyone that’s for it. What are you going to do with the trees when you cut them down?”

Darlene also questioned the fate of the trees in her role as county commissioner in the other RES class. This time she used a prop, a large town map displayed on the whiteboard in front of the classroom. She asks the Chamber of Commerce, “I wanted to ask; see these trees? All these trees? When you guys cut down the trees, are you guys going to replant these trees? What’s going on? And how are you going to pay for this?”

Subsequent to the simulation and county commissioner decision – denying renovations to the nature preserve – Darlene still wished that she could have directed more questions to the Chamber of Commerce as indicated below.

**Darlene:** We didn't know where the money was going to be coming from, but they were only telling us, ‘Okay, this is going to happen’ and ‘This is going to happen.’ I'm like, ‘Well, how are you going to make this happen or make this happen?’ They weren’t answering our questions. So I was like, ‘We should have put that [the questions] in there, because I know they are not going to answer it.’

**Phyllis:** Can you give me examples of maybe any – a question, a specific example – about cost and benefits that you would have asked them?

**Darlene:** What are the benefits of this project going to be? How much is this going to cost people in general for the people that live around there and the
animals? What is this going to do – around this area – what is this going to do to the animals that are there…in order for you to get a benefit out of it?

In this excerpt from our interview, Darlene approached the view of economics as a negative consequence for the Chamber of Commerce, unlike Bailey, who thought that inclusion of a lumber mill and campgrounds would boost the town’s economy. In discussing her group’s decision, Bailey was ambivalent up to the very end and was the deciding vote. Upon vocally wishing that the group could just inform Mr. J. that they could not reach a decision, I reminded the group that Mr. J told them that they should discuss their sides to come to an agreement. In response to this, the group began their discussion as viewed in the subsequent passage:

1. **Adam**: I believe that the good outweighs the bad. And the opportunity that the park brings to the area…like, it’s going to bring a lot of money to the area.
2.  
3. They’re going to gain a lot (**claim**).
4. **Katie**: I think – short term – it will bring all that stuff. But long term, it’s going to be worse, overall (**rebuttal**).
5. **Bailey**: (**laughing**) That’s why it needs to be undecided, kind of.
6. **Steve**: The only reason to do it is because of money. That’s what it seems like (**topical evidence**). They didn’t say anything about the community needs more money (**cognitive reasoning**). So that’s why I kind of feel they shouldn’t do it (**claim**).
7. **Katie**: And they never talked about how they are going to replant trees.
8.  
9. They’re just going to take them all up (**topical evidence**).
10. **Bailey**: Um, well, ok. I’m not going with the plan (**claim**).
11.  
12. **Katie**: You’re against it?
13. **Bailey**: Yeah.
14. **Katie**: Okay.

The brief time between Katie’s last claim and Bailey providing her own claim was extremely quick and quite jarring to see and hear. So much so, that I asked her about this during the interview. Bailey responded that her fellow commissioners who opposed a renovated nature preserve brought up very valid points to help her quickly make her decision.
As a citizen of the town, Brandy also had opportunities to evaluate the arguments of the special interest groups. She also struggled with the economic possibilities the addition of the lumber mill would bring to the simulated town. However, she also had a problem with the disruption of the natural environment. Her own lived experiences swayed her decision to keep the nature preserve unhampered. This will be further explored in Section 4.3.

4.2.3 APES students

4.2.3.1 Classroom discussion

I observed three APES students, Amy, Amber, and Kylie for my study. Please see Table 13 for the argumentation elements used during written work and classroom discussion. Kylie and Amber were participants and good friends that sat with a group of students who played sports for Riverwest. Kylie was a very good basketball player for the school while Amber did not play any sports. Still, Amber hung out with this group of students. Amy did not associate with Kylie and Amber but originally sat at a table next to her current seat. However, complaints about the hygiene of one student, Keith, prompted Amy to move next to the only students in the class (Diane and Shannon) who did not wish to be part of the study. This made it extremely difficult to obtain data for my study unless she sat near two other students, Jerome and Emily, who did agree to be a part of this study and who I will discuss later in this section.

Argumentation was focused on case studies that students either discussed in written form or in classroom discussion. Mr. J held class discussions on case studies related to gray wolves, marijuana and rodenticides, and zoos as educational resources.
during class time. In addition, one case study involving big horn sheep involved group presentations. In these classroom discussions, Mr. J. typically required students to first read the case study in the front of the classroom for participation points. Students often volunteered for these points. In terms of my study, Kylie and Amber were the first to volunteer to read in these case studies, but Amy never participated. In the actual discussions themselves, these students scarcely participated in class discussions except to ask questions of clarification (please see Table 13). This can be viewed beginning in line 1 of the first passage. In this segment, Kylie is discussing the marijuana and rodenticide study (Green & Wallat, 1981).

1. **Kylie:** I’m confused.
2. **Mr. J.:** Okay, We have a confusion question.
3. **Kylie:** I’m not really understanding this.
4. I mean, I know it’s about marijuana and stuff, but I’m not really…
5. *(gesturing her arm around and around at Mr. J. as if trying to find the right words)* understanding the question.
6. **Mr. J.:** Okay, let’s talk about this. So, first we got marijuana farms in the Northwest, correct?

Amy also sought clarification in line 3 below during the gray wolves case study class discussion. Beginning in line 9, Kylie also uses her statement as a way to clarify and summarize the case study.

1. **Kylie:** *(She turns and looks up at Mr. J.) Umhhhh… (she holds up her case study in front of her face).*
2. **Amy:** Okay. So wait, they just shooting wolves just to shoot them? Just because they don’t like them?
3. **Mr. J.:** Naaaah. They are reintroducing gray wolves back into Wisconsin. And what they’re talking about…is that public fear has risen as the wolf population has risen in Wisconsin. *(Kylie raises her hand tentatively to Mr. J. She takes her hand and covers her left eye with it).*
4. **Kylie:** So basically, *(She squints her eyes as she is stating this and looks down and then up)* this article is saying that if they see wolves, they are going to shoot ‘em no matter what they’re doing? *(Kylie waits for a response from Mr. J. Her mouth hangs open.)*
5. **Kylie:** I think? *(Kylie tentatively looks at Mr. J. and Darnell)
Table 13

Argumentative elements for written and classroom in APES

<table>
<thead>
<tr>
<th>Student</th>
<th>Chinese Takeout Summary (Class)</th>
<th>Chinese Takeout Summary (Written)</th>
<th>Marijuana &amp; Rodenticides (Class)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C</td>
<td>E</td>
<td>R</td>
</tr>
<tr>
<td>Kylie</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Amber</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Amy</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>S</th>
<th>Wolves (Class)</th>
<th>Wolves (Written work)</th>
<th>Zoo Case Study (class discussion)</th>
<th>Zoo Case Study (written work)</th>
<th>Bighorn Sheep (presentation)</th>
<th>Bighorn Sheep (written work)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C</td>
<td>E</td>
<td>R</td>
<td>C</td>
<td>E</td>
<td>R</td>
</tr>
<tr>
<td>Kylie</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Amber</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Amy</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

*Note. The symbols in the table are as follows: S – student, C – Claim, E – Evidence, R – Reasoning, S – Scientific, Co – Cognitive, Y-Yes, N – No, NA – Not Applicable, I - Incomplete*
14. **Mr. J:** Let’s pose this to the whole class. Kylie is saying that she thinks the article is saying that they are going to shoot the wolves if they see ‘em?

The limited participation of Kylie, Amber, and Amy overall during these discussions were made more apparent when compared to other students who participated in the classroom discussion. For this latter group of students, discourse strategies such as restating, clarification, and extending were used compared to the participants in the study (Wallat & Green, 1981). These strategies are known to aid in allowing content in message units to become more apparent for the intended audience, as in classroom discussions when students attempt to make their points known.

Although Mr. J. did not have the students read the zoo case study to the class, Amy was the first to quickly volunteer her answers, providing rationale for number 1 as seen below.

1. **Mr. J.**: Number one. I’m talking. All you gotta do is sit back and follow along.
2. **Amy**: I’m wishing that I could find it (*looking through her notebook*).
3. **Mr. J.**: ‘Number one. What is your reaction to the author’s statement that zoos should have an educational goal for people to understand and appreciate the natural world. However, because they’re focusing only on showing what animals in zoos; will face, difficult trade-offs between the zoo as a theme park and the zoo as an education/research center persist as an education/research center. What do you think the public reaction will be to exhibits that increasingly place education over entertainment?’
4. **Amy**: I said that zoos are meant to be educational, because you go to zoos to learn more about different animals…and how they live within their own environment. So I feel as though if the zoo was meant to be a theme park; that it would. It wouldn’t be a zoo.

Amy did not contribute more following her statement. Instead, her friend Diane, who’s father worked with zoos in the city took over the discussion with Mr. J while Amy remained silent. Interview questions with Amy ended up addressing Amy’s behavior during these discussions and why she often remained silent in class. For Amy, one of the reasons was due to other students in the class who had taken regular environmental
science class the year before, “Yeah. They [the students from last year RES] had an advantage because they knew what they were talking about and what he was saying. I didn't. I was lost at that.”

Still, Amy also dealt with other personal struggles during classroom discussions that ran deeper than simply remaining silent during classroom discussions. For Amy, the need to contribute thoughtful points that did not seem “stupid” to others determined if and when she would offer her opinions in class. She discusses this in terms of the gray wolves case study.

**Amy:** That [the gray wolves’ discussion] was the first, I think, discussion that we had. That's when I was lost, because how would you stop that? I said, ‘How would you know what to do when people are stealing something?’ Then I said, I didn't say it, but I was thinking, ‘Why won't you just pretend to be interested and see how they're doing it…how they’re doing it. You could probably come up with a way to stop that.'

**Phyllis:** That's what you wanted to say in class?

**Amy:** Yes, but then I thought that would be stupid. So then I was like, ‘Let's not say that.’

**Phyllis:** Why would you think that would be stupid? Because you did end up making a comment. You were asking about the wolves (reading from transcript) ‘What…people were just shooting wolves just to shoot them?’ You were trying to understand…you were trying to understand at that point. Then, once he explained it, you came up with this opinion? Were you worried that he was going to think it was stupid or is that something that you typically think of when you're in different classes – that you're not altogether comfortable with some of the content?

**Amy:** No. It's just because it's Mr. J and everybody else in there. When I answer a question, I usually know what I'm talking about. With that, I didn't know. I just don't want to say anything that's stupid. Not stupid, but that's not related to the topic. Because everyone else that said what they would do in that situation were really good at solutions. Mine was why wouldn't you just go undercover to see what they're doing. Just you can stop it by that. See? (after looking at Phyllis’s face) Yeah.

In an upcoming section discussing identity formation, Amy’s perspectives will be discussed further as it relates to her racial identity, which she revealed consistently throughout the interview when explaining her classroom behavior.
4.2.3.2 Use of Argumentation in written work: incomplete arguments

Please see Table 13 for a summary of the use of argumentation in written work.

Results were limited to the papers that were handed in to Mr. J. via Google Docs.

Overall, APES participants turned in paper work sporadically to Mr. J. Generally, Mr. J. prompted students to write a paragraph that contained at least 8 sentences which summarized the main ideas of the article. A second paragraph was also to be written that gave the student’s opinion of the case study. Mr. J. did not use a rubric to assess these case studies. Opinion statements that I evaluated on various issues were incomplete and incoherent. For instance, in regards to the zoo case study where the question posed was:

Number one. What is your reaction to the author’s statement that zoos should have an educational goal for people to understand and appreciate the natural world. However, because individuals are focusing only on showing what animals in zoos will have to face, difficult trade-offs between the zoo as a theme park and the zoo as an education/research center persist – what do you think the public reaction will be to exhibits that increasingly place education over entertainment?

Kylie’s written response:

I feel that they should have more education stuff [sic] because not only would be we able to see animals but we would be able to learn stuff also [sic] (claim) but when we have it we should make it more fun, not just boring educational facts but fun facts that you actually want to know [sic].

As one can see, this statement simply presents a claim with no evidence or reasoning. In actuality, after the claim is first stated, Kylie uses extending strategies to add more to the claim. In this case, Kylie extends the claim with the topic of adding “fun” to the zoo experience. However, without examples (i.e., possible evidence) or reasoning that connects her claim with these examples, it is difficult to assess the cohesiveness of Kylie’s response.
In comparison, Amber adds a reasoning component to her written claim, but still lacks the evidence needed that would fully make this a complete argument. For instance, Amber states,

Zoos are already educational, but they are also meant to be fun (claim). If one needs more information on the animal, I believe there are other places that can provide that information for students (cognitive reasoning).

She supports this in a statement that she asserts during the class discussion regarding this case study, by saying to Mr. J., "Yeah, they [zoos] could happen where education, with educational stuff in them. But you don't want it to be fact after fact after fact."

In a subsequent interview, however, Amber expounds on her claim with her own potentially cognitive reasoning.

Yeah. It takes away the feel of a zoo. I don't want to go to a zoo. I got to go to school. If I'm leaving school to go to on a field trip to the zoo to get some more school. I'm leaving school to go to school again.

In her interview, she also includes additional reasoning that may only be described as cognitive. In addition, she inserts her own lived experience of visiting a wildlife center in order to strengthen her argument in the interview.

There's plaques at zoos in front of the animals. They have facts that are important, but if you want to...you don't go to the zoo to be, like, okay, let's learn (claim). You go to the zoo to look at the animals, and get a little of the facts. If you want to learn about the animal, then go to a wildlife center – where I went before to learn about some owls (potential cognitive reasoning). Owls scare me. They really do. They look at you with those piercing eyes.

She discusses this more shortly after her remark, inserting personal evidence to form a type of argument, something she has not done on paper.

Zoos, you look at the animal (claim). You think it's cool. You see little kids, like 2-year-olds. My brother, he's 5. He doesn't want to learn at the zoo (personal evidence), because he's not at the age to learn (cognitive reasoning). He's at the age to look at the tiger and know it's orange and black. You know what I mean?
In another case study, students read information on the Chinese culture and their typical practices of consuming a variety of animals in order to survive. In this instance, students also had to summarize the case study in one paragraph and then provide their opinion in the second paragraph. This is Kylie’s second paragraph where she offers her insight into this cultural practice.

My opinion about this story is shocking, I did learn a couple new things [sic]. The main conflict in this article I felt like I knew that the Chinese already ate everything [sic]. But when they start to talk about the turtles and how they are starting to be extinct because of them eating them I did get in my feelings [sic]. I feel out of all the animals a turtle is the most innocent, and also the most animal that’s harmless just wants to protect their self with that shell [sic] (claim). For them to just eat it I feel it is not fair at all, but when it comes to their age [sic]. That was one of the many thing that shocked me. I didn’t know that a turtle that you see today could possibly be a turtle from world war 1, that is a really long time never knew that a turtle could be that old [sic].

In reviewing Kylie’s response, it is clear that her expressed thoughts do not form a coherent and cohesive statement. She begins her response with what she already knows, the expansive Chinese diet. From there, she begins a claim regarding the innocence of turtles and the injustice of eating these animals. However, she does not offer anything else. Instead, she uses a raising strategy by switching to another topic, the age of turtles (Green & Wallat, 1981). From this paper alone, it is difficult to understand the purpose of this assignment as Kylie’s response does not seem to be a formal one with much structure. This response along with the others reviewed are similar in their ambiguity.

However, while Kylie at least states a claim, Amber does not with the same assignment – focusing only on giving a short summary as seen here.

In the beginning of the Chinese Take Out article, the author touches on how the Chinese people eat different, weird, exotic foods, including the genitals of various different animals including skinned dog and cat carcasses, tiny roasted pigeons, and everything else in between [sic]. It’s believed that the Chinese’ open minded attitude is because they believe that every animal part has medicinal benefits/sic/.
Then the article switched to talking about the life of wild turtles and how they are being used to supply food markets in Asia. The turtle population has been dropping dramatically because of this. This article begins to focus greatly on the turtle population now.

After a while, I noticed that Mr. J. was displeased with the quality of the homework responses he was receiving by way of these case studies. Following a class field trip, approximately one month into the study, Mr. J. realized that the students needed more explicit guidance when evaluating case studies. In regards to the bighorn sheep case study described in the next section, students – including the participants – were able to complete their assignments when Mr. J. was more clear with his directions.

4.2.3.3 Classroom presentations

4.2.3.3.1 Bighorn sheep case study- incomplete to complete arguments (with clarity).

One day, Mr. J. discovered a bighorn sheep case study online from professors at Washington University of St. Louis (Clark, nd). This study would allow the APES students to read about the declining populations of bighorn sheep near the Rocky and Sierra Nevada mountains caused by mountain lions. APES students had to choose one of two opposing sides of Congress. One side wanted to ensure that the bighorn sheep population was protected by culling mountain lions – controlled killing each year. However, another group of senators were satisfied with current legislative measures. These measures limited the culling of mountain lions to protect domesticated pets. The students were to read the proposed alteration of the act to protect the bighorn sheep. Mr. J. advised students with his original instructions to pose their position statement based on the arguments presented in the fictional debate. Their position statement was to include a main statement that voiced their claim. They were also to provide rationale for their claim.
using the primary resource of the case study as well as one other independent resource. Students were to write approximately 16 sentences that expressed their position.

The assignment erupted in confusion for the students. The following day, a frustrated Mr. J. told me that students had turned in work that was unacceptable. Because of this, he was offering them a chance to redo the assignment. Although Amber was out of town on holiday, he informed me that Kylie spent approximately an hour after school with Mr. J on the case study the previous afternoon. Kylie had been motivated to approach Mr. J. due to her own confusion with the assignment. Mr. J. had not offered a rubric to the students or provided any examples of what he was assessing in this project.

Kylie discussed her frustration during this assignment in the interview.

The instructions weren't good at all. Because not everybody, nobody really understood what we were doing. I was the only one – me and this other guy – was the only ones that got it done the way he wanted it, because we stayed after school [sic]. Yeah. And he [Mr. J.] basically, like, talked me through it. And he helped me through it. But the other ones that weren't there and wasn't done on time was because he didn't explain it right [sic]. He asked…like…do you have what you need? After you have what you need, then you need to go with this. and like he made it like, like, how it should be with you, with the teacher. If he would have explained it like that in class, then it would have been…it would have been done the next day. But by him not explaining it, it made everybody like…that's why I stayed after, because I knew for a fact I wasn't going to get it done if I would have just went home by myself like everybody else did.

However, Amy disagreed. Besides Kylie and Isaiah, who had received help from Mr. J, Amy had not received help from Mr. J, nor did she choose to redo the assignment.

Amy’s problems consisted of a common theme with her schoolwork, her need for perfection. In her interview, recalling the incident, she states,

The thing is, people – Mr. J. did say all those things [instructions]. He did. The citation part just wasn't clear enough. For me, I didn't like my paper because I'm a person who has to plan out what I'm going to write. I'm a really good writer, and I just have – I'm organized. To me, that's – I'm a person who just has to plan everything out to the way that I like it. Just having one day, I just threw stuff
together and copied and pasted. Just put together what I thought went along with my claim. I didn't like that part. When I read it out loud, I was mad because I did not like that at all.

Please see Figures 11 and 12 for Amy’s and Kylie’s position statement. From comparing the two position statements, one can see that Kylie’s polished paper was indeed influenced by Mr. J. In it, she depicts a position that discusses not the culling of mountain lions, but the influx of domesticated sheep into the area as well as natural consequences of global warming. In this paper, her claim states that fellow congresspeople should discuss the need for curtailing domestic sheep and the need to minimize the anthropogenic affects of global warming. She uses the scientific evidence of global warming (i.e., harsher climates and poorer vegetation) as well as a correlative statement regarding the appearance of domesticated sheep with the disappearance of bighorn sheep. Her reasoning is also cognitive by stating that the consequences of global warming are making it difficult for the bighorn sheep to find proper food and water to survive and reproduce.

In contrast, Amy relies on a different approach. One can tell with her extended use of a direct quotation and the rest of her paper that she is indeed somewhat confused with the assignment. However, her major claim involves stating that animals should not be removed. Instead, such animals, including the mountain lion and bighorn sheep should be allowed to live in their natural habitat. As a way to support this, she relies on scientific evidence in the form of a direct quotation that discusses the disappearance of bighorn sheep by way of anthropogenic influences.
Hello fellow state senators, the issue of the big horn sheep and the Mountain lion in my opinion comes down to the importance of the big horn sheep and the issues that affect the sheep besides the mountain lions. Cutting the mountain lions is not the problem; the problem is the domesticated sheep that were brought into areas that were already inhabited by the big horn sheep that starts to affect them negatively. A quote from United States Magistrate Judge Donald C. Ashman says that "scientific research supports a finding that when big horn sheep intermingle with domestic sheep, large numbers of big horn sheep die. While the actual reason for this result may be in question, it is clear that the die-offs occur. An incompatibility exists between the two species and there is no way to avoid the incompatibility other than to keep the domestic and the bighorns separate."

Not only are the domestic sheep affecting the big horn sheep but global warming is also making their survival difficult. It starts by the precipitation decreasing which reduces the amount of vegetation available for foraging and the freshwater springs that the sheep depend on for water. The sheep are becoming more at risk because of the southwestern climate continuing to become hotter and dryer. This change in climate makes it harder for the big horn sheep to find food and water. I think you should consider my side and vote against a bill that would be more towards saving a sheep then killing another mountain lion.

http://www.bighorndiseaseinfo.org/

Figure 11 Kylie’s position statement on bighorn sheep

She also uses an extending strategy as a way to add more to her claim, or perhaps, provide an additional one, by implicating that the numbers of mountain lions and bighorn sheep may suggest that bighorn sheep are in danger, but these animals may still be transplanted to different areas in order to thrive. There is no actual form of reasoning that is used in Amy’s statement that aids in the coherency of her argument. As such, the paper seems to present an incomplete argument.

Another opportunity arose for me to further assess argumentation by way of a field trip. Still, I found some incongruency between the resources that Mr. J used to facilitate argumentation in the classroom and what the students actually used for their resulting presentations as found in the next section.
Ladies and gentlemen of the senate, there has been a great uproar about the declining numbers in the bighorn sheep. I urge you to consider the fact that every animal has the right to abide by its natural characteristic, whether those be hunting, mating, or protecting its family. Many people fail to realize that bighorns were wretched away even before the mountain lions came to play. “Bighorn sheep were extirpated from the Catalinas during the late 1990s, yet the specific reason for their disappearance will never be fully understood. Factors contributing to the herd’s decline and ultimate extirpation include reduced habitat quality due to a long regime of fire suppression and human disturbance from increased recreation and urbanization. Other factors potentially contributing to their extinction included disease and predation. Increased predation on bighorn sheep by mountain lions may also have been related to increased vegetation growth due to fire suppression.” Furthermore, many people would like to believe that due to the correlation between the mountain lions and bighorn sheep, that they are an endangered species in state of the country. “Today, populations have been re-established through transplanting sheep from healthy populations into vacant places.” Overall, what I’m trying to proclaim is that we should not kill an animal or any animal that acts based on its natural instinct.


**Figure 12** Amy’s position statement on bighorn sheep

### 4.2.3.3.2 Field trip.

#### 4.2.3.3.2.1 Ambiguous use of argumentation – Kylie and Amber.

The field trip that Mr. J. arranged for his APES students occurred along a Midwestern river. Please see Figure 13 for one of the pictures I took on this trip. The purpose of this field trip was two-fold. First, students were to complete a lab that involved assessing the habitat of the region including studying the macrointervetrabes in the river, dissolved oxygen levels, temperatures, soil erosion, etc. Also, students were required to design and construct their own experiment (in pairs). Although this field trip was something Mr. J. was excited about and encouraged me to come along, which I did
quite happily, I struggled to find the argumentative elements in this trip. Part of this
difficulty involved the lack of clear instructions on the actual assignment itself.

![Figure 13 Mr. J. demonstrating kick-net during field trip](image)

In preparation for this trip, Mr. J. gave the students several papers: a biological
monitoring data sheet which guided students into collecting information regarding the
climate and natural habitat, a key of all the possible organisms in the river, and a handout
that he borrowed from a colleague, Mr. T., who taught biology in an adjoining classroom.
The handout from Mr. T followed the McNeill & Krajcik argumentation model (2012).
Please see Figure 14 for a modified version of the handout that Mr. J. used in class.
What a Scientific Explanation Looks Like

1. Make a claim about the problem
A claim is a statement of your understanding about the thing you are investigating. You can make claims about the evidence you gather in a lab, or that you learn about in other aspects of this course. You can even make claims about things that aren’t in this course at all (but let’s focus on science-related claims for the purpose of this document). You should expect that your claim will have the following properties:
   - It’s at least one complete sentence in length (it’s probably only one complete sentence in length).
   - It will be the first sentence(s) in your explanation.
   - If it’s a claim about a specific question, it answers that question.
   - If it’s a claim about the relationship between two variables, it will describe the relationship between those variables.

2. Provide evidence for the claim
Evidence is data. Data comes from a lot of places. You will gather data in labs, and you will be provided with data that supports all other aspects of this course. Over time, you will learn what types of data are best used to support particular claims. You should expect evidence will have the following properties:
   - The evidence will be sufficient to answer the claim. In other words, there will be enough of it.
   - The evidence will be appropriate for the explanation. In other words, it will be connected.
   - The data will be interpreted, not just listed. An explanation of what the data shows, and how that supports the claim will be provided.
   - Superfluous data that may be generated during an investigation will not be used to justify a disconnected claim.

3. Use reasoning that links the evidence to the claim
Reasoning is the tricky part of generating an explanation. Anyone can make a claim. And anyone can supply evidence for a given claim. But the ability to use logically consistent reasoning when constructing a claim is what separates good scientists from hacks. You should expect that your reasoning will have the following properties:
   - Reasoning will be based on scientific principles- accepted understandings in science.
   - Reasoning will also show how a particular principle connects particular evidence to a particular claim.
   - Some folks have suggested that it’s helpful to think of reasoning as a bridge that connects the evidence to the claim.

Figure 14 CER-R handout for Mr. J.’s field trip

This handout contained the definitions of claim, evidence and reasoning as well as guides or pointers that students could refer to that would help them understand the use of
these terms. Mr. J. provided this handout to the students the next day as an aid for the designing of their experiment. Because he wanted the students to be more independent in their own learning, he was not entirely clear as to how he wanted the students to incorporate the model into the design of the experiment itself as found from this exchange when Amber walked up to Mr. J.’s desk with the handout requesting clarification.

1. Amber: We’re suppose to be using this for our experiment?
2. Mr. J: Yeah, you’re going to use that to help design it.
3. Amber: Where are we putting our question?
4. Mr. J. Right here (pointing to the area under claim)

In all my observations, however, the students never used this CER-R worksheet. One possible reason was the field trip’s series of unfortunate events (e.g., stuck and overturned canoes, having the residents call the police on Mr. J.’s class, strong currents, etc.) that resulted in the students not collecting sufficient data that would address their questions. As a way to reconcile the trip, Mr. J advised them to figure out ways to combine the class data (if they should choose) to aid with the creation of their presentations. I asked Amber about her understanding of the McNeill and Krajcik worksheet that Mr. T. created (2012).

Amber: I didn't understand that, because it was so vague. I could have used that in my English class. I could use that to write a paper. He said, ‘Just write your question here.’ I can't really ...
Phyllis: Write your question where?
Amber: Under claim.
Phyllis: Okay.
Amber: Like I said, it wasn't specifically for AP Environmental. I would like it if we could ... I know you can't spoon feed me. But let me know a little more in depth what I'm supposed to be doing, so I can have a better understanding.

Amber, a very bright student with a high standardized test scores was so unclear of the use of the McNeill & Krajcik model, that she believed it wasn’t really suited for her
environmental class (2012). In actuality, this model was created originally for students who are learning environmental science (McNeill & Pimentel, 2010).

Amber and Kylie continued to struggle with the design of their experiment for the field trip. Please see Table 14 for discourse analysis related to this exchange. Again, for ease of presentation, the line numbers of this passage are associated with the written description.

1. **Amber:** He said we should word it differently, because there's no way we're going to be able to measure water in deep – measure plants in deep water.
2. **Amber:** Because when we get out there, it's not going to really be time to stop. It's just going to be moving.
3. **Kylie:** Wait. When we have to measure in the plants, how would we know –
4. **Amber:** He said measure the different water levels. We’re going by plants at the water level.
5. **Kylie:** I thought we were just studying the different plant life around the different water levels.
6. **Amber:** Exactly. He said, how are we supposed to know the different water levels and where to study the plants?
7. **Kylie:** I don't know. This is too much. I don’t know what to do with it.
8. **Amber:** Tom, what are y’all doing? They're doing the heat…temperature.
9. **Kylie:** Meaning…
10. **Amber:** Like I'm trying to figure it out, so I won't be doing the same thing y’all are doing.
11. **Tom:** Me and Brian are testing – we’re finding records of pH levels. We're going to be finding pH from like 4 years ago. And we're going to get the water, and we’re going to test the water now. So we're going to see if, like, acid rain is affecting the pH levels in the water, if it's making the water acidic.
12. **Amber:** We need help with number one. I was going to say test – I was going to say, like, to see if the temperature is different, closer to the water, closer to the shore, closer than how it is than like towards the middle of the water.
13. **Tom:** That would work.

In this exchange, one can see that Kylie used clarification strategies with Amber in lines 5, 8, and 16 (Green & Wallat, 1981). She expressed her frustration in line 12 with the message that Amber has relayed from Mr. J. Lines 1 to 11 emphasize a confusion over what Kylie and Amber should actually measure in their claim, which originally
stated the need to assess different plant life based on the various water levels. As a way to create a claim that could actually be supported or rejected, Mr. J. attempted to provide Amber guidance with how to construct the claim, something that Amber attempted to relay to Kylie. However, slight thematic shifts (from the original claim of assessing plant life around different water levels to ensuring that the water levels are measured at each stop with regards to the various plant life) seemed to add to the confusing statement for Kylie. In line 23, after checking in with her friend Tom, Amber decided to assess the temperature of the water with respect to the various plant life, something that she did not clarify with Kylie but a choice that was approved by Tom.

**My role as teacher/observer**

I found myself playing the role of a teacher when Kylie came up to Mr. J at the end of the class and admitted that she was not ready for the trip. She also admitted her fear of water. Mr. J. and I assured she would be fine. Mr. J., an avid outdoorsman, told her we would help protect her in the water and that I would help Kylie and Amber with their experiment. Although taken aback and somewhat concerned about how my role would influence the study, I agreed to help. After a brief discussion, they decided to assess the growth of aquatic plants via height at various water levels. Their claim, they stated, was that the plants would be higher in lower levels of water because of greater exposure from the sun. Kylie and Amber never followed through on this experiment as I implicated earlier due to the surprises that occurred on the field trip. Instead, the students combined their data and findings with their friends, Troy and Trevor, identical twins in the class, in an experiment to test the turbidity of river water.
Table 14

Discourse analysis of Amber and Kylie for field trip

<table>
<thead>
<tr>
<th>Line number</th>
<th>Message unit</th>
<th>Contextualization cue (CC)</th>
<th>Conversation strategies</th>
<th>Loc. of Know.</th>
<th>Conversation strategies</th>
<th>Loc. of Know.</th>
<th>Argument codes</th>
<th>Interaction units (lines)</th>
<th>Social interaction</th>
<th>Linguistic evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>He said we should word it differently</td>
<td>Looking at Kylie with Kylie sitting next to her; talking fast but pauses at end of message unit</td>
<td>Response</td>
<td>Amber</td>
<td>Focusing</td>
<td>Amber</td>
<td>NA</td>
<td>1-12</td>
<td>Kylie</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>2</td>
<td>because there's no way we're going to be able to measure water in deep water</td>
<td>Looking at Kylie with Kylie sitting next to her; talking fast but pauses at end of message unit</td>
<td>Response</td>
<td>Amber</td>
<td>Clarifying</td>
<td>Amber</td>
<td>NA</td>
<td>1-12</td>
<td>Kylie</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>3</td>
<td>It's just going to be moving.</td>
<td>Looking at Kylie with Kylie sitting next to her; talking fast but pauses at end of message unit</td>
<td>Response</td>
<td>Amber</td>
<td>Confirming (+)</td>
<td>Amber</td>
<td>NA</td>
<td>1-12</td>
<td>Kylie</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>Line number</td>
<td>Message unit</td>
<td>Contextualization cue (CC)</td>
<td>Conversation strategies</td>
<td>Loc. of Know.</td>
<td>Conversation strategies</td>
<td>Loc. of Know.</td>
<td>Argument codes</td>
<td>Interaction units (lines)</td>
<td>Social interaction</td>
<td>Linguistic evidence</td>
</tr>
<tr>
<td>-------------</td>
<td>--------------</td>
<td>---------------------------</td>
<td>-------------------------</td>
<td>--------------</td>
<td>-------------------------</td>
<td>--------------</td>
<td>----------------</td>
<td>--------------------------</td>
<td>------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>4</td>
<td>Wa+it</td>
<td>Looking down at paper. Pause at end of “wait; elongation of wait</td>
<td>Response</td>
<td>Kylie</td>
<td>Confirming (+)</td>
<td>Kylie</td>
<td>NA</td>
<td>1-12</td>
<td>Kylie</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>5</td>
<td>when we have to measure in the plants, how would we know</td>
<td>Looking at Amber; talking slowly</td>
<td>Question</td>
<td>Amber</td>
<td>Clarifying</td>
<td>Amber</td>
<td>NA</td>
<td>1-12</td>
<td>Kylie</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>6</td>
<td>He said measure the different water levels</td>
<td>Looking at Kylie; talking fast; flat intonation</td>
<td>Response</td>
<td>Amber</td>
<td>Clarifying</td>
<td>Amber</td>
<td>NA</td>
<td>1-12</td>
<td>Kylie</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>7</td>
<td>we’re going by plants at the water level.</td>
<td>Looking at Kylie; talking fast; flat intonation</td>
<td>Response</td>
<td>Amber</td>
<td>Clarifying</td>
<td>Amber</td>
<td>NA</td>
<td>1-12</td>
<td>April</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>8</td>
<td>I thought we were just studying the different plant life around the different water levels.</td>
<td>Looking at Amber; face scrunched up; pause at “levels”</td>
<td>Response</td>
<td>Kylie</td>
<td>Clarifying</td>
<td>Kylie</td>
<td>NA</td>
<td>1-12</td>
<td>With group</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>9</td>
<td>Exactly</td>
<td>Looking at Kylie; flat intonation with “exactly”</td>
<td>Response</td>
<td>Amber</td>
<td>Clarifying</td>
<td>Amber</td>
<td>NA</td>
<td>1-12</td>
<td>With group</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>Line number</td>
<td>Message unit</td>
<td>Contextualization cue (CC)</td>
<td>Conversation strategies</td>
<td>Loc. of Know.</td>
<td>Conversation strategies</td>
<td>Loc. of Know.</td>
<td>Argument codes</td>
<td>Interaction units (lines)</td>
<td>Social interaction</td>
<td>Linguistic evidence</td>
</tr>
<tr>
<td>-------------</td>
<td>------------------------------------------------------------------------------</td>
<td>----------------------------</td>
<td>-------------------------</td>
<td>---------------</td>
<td>-------------------------</td>
<td>---------------</td>
<td>-----------------</td>
<td>------------------------</td>
<td>--------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>10</td>
<td>he said how are we supposed to know the different water levels and where to study the plants.</td>
<td>Looking at Kylie; Amber is talking quickly</td>
<td>Response</td>
<td>Amber</td>
<td>Clarifying Restating</td>
<td>Amber</td>
<td>NA</td>
<td>1-12</td>
<td>With group</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>11</td>
<td>I don’t know.</td>
<td>Looking at her paper; looking down</td>
<td>Response</td>
<td>Kylie</td>
<td>Confirming (-)</td>
<td>Kylie</td>
<td>NA</td>
<td>1-12</td>
<td>With group</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>12</td>
<td>This is too much. I don’t know what to do with it</td>
<td>Looking at her paper; looking down</td>
<td>Response</td>
<td>Kylie</td>
<td>Confirming (-)</td>
<td>Kylie</td>
<td>NA</td>
<td>1-12</td>
<td>With group</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>13</td>
<td>Tom, what are y’all doing</td>
<td>Looking at Tom</td>
<td>Question</td>
<td>Tom</td>
<td>Clarifying</td>
<td>Tom</td>
<td>NA</td>
<td>NA</td>
<td>To Tom</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>14</td>
<td>They’re doing the heat, temperature</td>
<td>Turns head to Kylie; lowered voice</td>
<td>Response</td>
<td>Amber</td>
<td>Clarifying</td>
<td>Amber</td>
<td>NA</td>
<td>NA</td>
<td>Kylie</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>15</td>
<td>What are y’all doing exactly↑</td>
<td>Raised intonation from previous unit; raised intonation at “exactly”</td>
<td>Question</td>
<td>Amber</td>
<td>Clarifying</td>
<td>Amber</td>
<td>NA</td>
<td>15-16</td>
<td>Tom</td>
<td>Ccs and content of message unit</td>
</tr>
</tbody>
</table>
Table 14 – Continued

<table>
<thead>
<tr>
<th>Line number</th>
<th>Message unit</th>
<th>Contextualization cue (CC)</th>
<th>Conversation strategies</th>
<th>Loc. of Know.</th>
<th>Conversation strategies</th>
<th>Loc. of Know.</th>
<th>Argument codes</th>
<th>Interaction units (lines)</th>
<th>Social interaction</th>
<th>Linguistic evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>I’m checking pH levels in the water and shit</td>
<td>Looking at Amy and Kylie</td>
<td>Response</td>
<td>Tom</td>
<td>Clarifying</td>
<td>Tom</td>
<td>NA</td>
<td>16-17</td>
<td>With Amber and Kylie</td>
<td>CCs and content of message unit</td>
</tr>
<tr>
<td>17</td>
<td>Meaning</td>
<td>Kylie looking at Tom; question but no raised intonation at the end</td>
<td>Question</td>
<td>Tom</td>
<td>Clarifying</td>
<td>Tom</td>
<td>NA</td>
<td>16-17</td>
<td>With Amber and Kylie</td>
<td>CCs and content of message unit</td>
</tr>
<tr>
<td>18</td>
<td>Like I’m trying to figure it out, so I won’t be doing the same thing y’all are doing</td>
<td>Looking Tom</td>
<td>Response</td>
<td>Amber</td>
<td>Extending/Clarifying</td>
<td>Amber</td>
<td>NA</td>
<td>18-20</td>
<td>With Tom</td>
<td>CCs and content of message unit</td>
</tr>
<tr>
<td>19</td>
<td>Me and Brian are testing</td>
<td>Looking at Amber and Kylie; talking quickly to them both in a rushed manner but smiling</td>
<td>Response</td>
<td>Tom</td>
<td>Extending</td>
<td>Tom</td>
<td>NA</td>
<td>18-20</td>
<td>With Amber and Kylie</td>
<td>CCs and content of message units</td>
</tr>
<tr>
<td>20</td>
<td>We’re finding the records of pH levels.</td>
<td>Looking at Amber and Kylie</td>
<td>Response</td>
<td>Tom</td>
<td>Extending</td>
<td>Tom</td>
<td>NA</td>
<td>18-26</td>
<td>With Kylie and Amber</td>
<td>CCs and content of message unit</td>
</tr>
<tr>
<td>21</td>
<td>We’re going to finding pH from like 4 years ago</td>
<td>Looking at Amber and Kylie</td>
<td>Response</td>
<td>Tom</td>
<td>Extending</td>
<td>Tom</td>
<td>NA</td>
<td>18-26</td>
<td>With Kylie and Amber</td>
<td>CCs and content of message unit</td>
</tr>
<tr>
<td>Line number</td>
<td>Message unit</td>
<td>Contextualization cue (CC)</td>
<td>Conversation strategies</td>
<td>Loc. of Know.</td>
<td>Conversation strategies</td>
<td>Loc. of Know.</td>
<td>Argument codes</td>
<td>Interaction units (lines)</td>
<td>Social interaction</td>
<td>Linguistic evidence</td>
</tr>
<tr>
<td>-------------</td>
<td>--------------</td>
<td>----------------------------</td>
<td>-------------------------</td>
<td>---------------</td>
<td>-------------------------</td>
<td>---------------</td>
<td>-----------------</td>
<td>-------------------------</td>
<td>-------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>22</td>
<td>And we’re going to get the water</td>
<td>Looking at Amber and Kylie</td>
<td>Response</td>
<td>Tom</td>
<td>Extending</td>
<td>Tom</td>
<td>NA</td>
<td>18-26</td>
<td>With Kylie and Amber</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>23</td>
<td>And we’re going to test the water now</td>
<td>Looking at Amber and Kylie</td>
<td>Response</td>
<td>Tom</td>
<td>Extending</td>
<td>Tom</td>
<td>NA</td>
<td>18-26</td>
<td>With Kylie and Amber</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>24</td>
<td>So we’re going to see if like acid rain is affecting the pH levels in the water.</td>
<td>Looking at Amber and Kylie</td>
<td>Response</td>
<td>Tom</td>
<td>Extending</td>
<td>Tom</td>
<td>NA</td>
<td>18-26</td>
<td>With Kylie and Amber</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>25</td>
<td>If it’s making the water acidic</td>
<td>Looking at Amber and Kylie</td>
<td>Response</td>
<td>Tom</td>
<td>Extending</td>
<td>Tom</td>
<td>NA</td>
<td>18-26</td>
<td>With Kylie and Amber</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>26</td>
<td>We need help with another one.</td>
<td>Looking at Tom. Pause at “one”</td>
<td>Response</td>
<td>Amber</td>
<td>Focusing</td>
<td>Amber</td>
<td>NA</td>
<td>18-26</td>
<td>With Tom</td>
<td>CCs and content of message unit</td>
</tr>
<tr>
<td>27</td>
<td>I was going to say test-</td>
<td>Looking at Tom; pause at “test”</td>
<td>Response</td>
<td>Amber</td>
<td>Focusing</td>
<td>Amber</td>
<td>NA</td>
<td>18-26</td>
<td>With Tom</td>
<td>CCs and content of message unit</td>
</tr>
<tr>
<td>28</td>
<td>I was going to say, like, to see if if the temperature is different</td>
<td>Flat intonation throughout.; looking at Tom</td>
<td>Response</td>
<td>Amber</td>
<td>Editing/Extending</td>
<td>Amber</td>
<td>NA</td>
<td>18-26</td>
<td>With Tom</td>
<td>CCs and content of message unit</td>
</tr>
<tr>
<td>Line number</td>
<td>Message unit</td>
<td>Contextualization cue (CC)</td>
<td>Conversation strategies</td>
<td>Loc. of Know.</td>
<td>Conversation strategies</td>
<td>Loc. of Know.</td>
<td>Argument codes</td>
<td>Interaction units (lines)</td>
<td>Social interaction</td>
<td>Linguistic evidence</td>
</tr>
<tr>
<td>-------------</td>
<td>----------------------------------------</td>
<td>------------------------------------------------------------------------------------------</td>
<td>-------------------------</td>
<td>---------------</td>
<td>-------------------------</td>
<td>---------------</td>
<td>----------------</td>
<td>------------------------</td>
<td>---------------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td>29</td>
<td>Closer to the water, closer to the shore</td>
<td>Beginning again; flat intonation throughout; looking at Tom</td>
<td>Response</td>
<td>Amber</td>
<td>Editing</td>
<td>Amber</td>
<td>NA</td>
<td>18-26</td>
<td>With Tom</td>
<td>CCs and content of message unit</td>
</tr>
<tr>
<td>30</td>
<td>Closer than how it is than like towards the middle of the water</td>
<td>Beginning again; flat intonation throughout; looking at Tom</td>
<td>Response</td>
<td>Amber</td>
<td>Editing/Extending</td>
<td>Amber</td>
<td>NA</td>
<td>18-26</td>
<td>With Tom</td>
<td>CCs and content of message unit</td>
</tr>
<tr>
<td>31</td>
<td>That would work</td>
<td>Tom looking at Amber</td>
<td>Response</td>
<td>Tom</td>
<td>Confirming (+)</td>
<td>Tom</td>
<td>NA</td>
<td>18-26</td>
<td>With Amber</td>
<td>CCs and content of message unit</td>
</tr>
</tbody>
</table>

*Note.* Loc. of Know. is the location of knowledge found in the message unit.
Figure 15 Introduction slide of Kylie and Amber's group

Figure 16 Kylie and Amber's group defining turbidity
Kylie’s group had no real introduction in their presentation. They simply stated, “We chose to study the turbidity of water.” The students did not present any clear claim to the rest of the class. Please see Figures 15 to 17 for the slides used during their class presentations.

Although the students were expected to use the CER-R handout (McNeill & Krajcik, 2012), it is clear that Kylie and Amber’s group did not rephrase their conclusions in ways that showed a restatement of a claim. However, the conclusive statement itself did resemble a claim as shown in the underlined portion of the slide in Figure 17. While the group extended on the claim by defining turbidity in their conclusion, they did not provide a summative statement regarding evidence, nor did they use rationale as a way to connect the evidence with their conclusive statement.
4.2.3.3.2.2 Amy and Jerome – thesis=claim.

Although Amy’s tablemates included two White female students who did not want to be part of this study, I was fortunate to have her also sit next to and work with a bright young man named Jerome who agreed to be captured on video and audio. Jerome was a young African-American male who was actually the youngest student in the class (a junior). It was also common knowledge in the classroom that Jerome was extremely intelligent and the students seemed to admire his quirky brilliance. Amy immediately chose to work with him for the field trip because as she told me, “He’s really smart. He’s very smart.”

Amy allowed Jerome to take the lead in the design of the experiment. She responded, “Hecks yeah!” when I asked if she trusted him with leading a well-designed study. In comparison to Kylie and Amber, who had challenges constructing a question or statement to study, Amy and Jerome designed a study where they created a thesis statement that served as the claim as shown in Figure 18. This occurred even though the two students did not follow the CER-R worksheet that Mr. J had given the class as Amy confirmed in an interview.

1. Phyllis: Did you remember when he gave you a worksheet in regards to that?
2. Not just the lab itself, but he gave you another worksheet – the claim, evidence, reasoning one?
3. Amy: Yeah.
4. Phyllis: Did you understand what that meant? What you were supposed to do with that?
5. Amy: I did, but I forgot got all the steps with the scientific method. I forgot all the steps for that. I liked the first two parts, but then the rest of it was actually trying to put it together to actually sound like you know what you’re doing.
6. That's it.
7. Phyllis: Did you use that particular worksheet to help, or did you use the scientific method and emphasize that more?
8. Amy: For the experiment?
15. **Amy**: Really, we really didn't go off that at all.
16. **Phyllis**: What did you –
17. **Amy**: Doing our experiment, we just did – I don't think anybody followed
18. their procedure – or whatever – about what they were going to do. I guess that
19. just threw out the window. We just did our own thing, at least. We really
20. did not follow that at all.

In my typical interview excerpts, I have not enumerated the passage. However, with
Amy’s interview, line numbers are absolutely necessary to explain what occurred during
this time. From the above passage, one can see that Amy confused the CER-R model
with the steps of scientific method (line 7). She also shows some confusion over my
question by unknowingly introducing a thematic shift in her message to me (Bloome et
al., 2005). A thematic shift occurs when the content of the message unit switches to
another theme that may or may not be understood by its intended audience (Bloome et
al., 2005). This is apparent in line 17, where Amy begins to discuss the procedure of the
experiment (a shift from both the CER-R model and scientific method that I initiated in
line 5). In the following passage, one can see how Jerome and Amy use a combination of
clarification strategies and thematic shifts to understand the difference between the
question and thesis statement, though the presentation shows that they eventually chose
to state their claim/thesis statement in the end. The analysis for this exchanged can be
found in Table 15. Please note that the line numbers below do not directly reflect the line
numbers in Table 15.

1. **Amy**: For our question, we're trying to find the oxygen levels. So how would
2. you set up the question?
3. **Jerome**: Restate your question because it wasn't very clear.
4. **Amy**: Okay. So, like the writing part of the whole entire lab, we need to come
5. up with a question.
6. **Jerome**: A thesis?
7. **Amy**: No.
8. **Jerome**: You mean the question that we're answering?
9. **Amy**: What is the question?
10. **Jerome**: What is the effect? What is the effect of stream flow on dissolved oxygen levels?

11. **Amy**: Stream flow?

12. **Jerome**: Stream flow on dissolved oxygen levels.

In the previous passage, Amy’s contextualization cues continued to show some confusion in her understanding the steps of conducting an experiment. This was made apparent when she chose strategies such as clarification as seen in line 1 and to a smaller degree, line 9 (Green & Wallat, 1981). In the following passage, she also asks for clarification in line 1. This is confirmed as the appropriate strategy when viewing Emily’s response where she indeed clarifies the steps of the “scientific method” in lines 2, 6, 8, and 10.

1. **Amy**: That's your case study? What…you're doing a case study?
2. **Emily**: Experiment would be too hard. Because, I mean, then you have to, like, do the whole entire experiment process: control group, hypothesis. You have to actually conduct the experiment.
3. **Amy**: That's not hard.
4. **Emily**: I mean you have to follow like the...what is it...the seven thing…
5. **Amy**: It's like...
6. **Emily**: The experimental process.
7. **Amy**: I forgot everything from seventh grade.
8. **Emily**: Control group, independent variable, dependent variable – you have to do like all that. No, thank you. I'm not that way. I'd honestly like to just record things than to conduct an actual experiment.

Please see Figure 18 and 19 for slides of Amy and Jerome’s field trip presentation.

Amy and Jerome worked well together according to my observations as you can see in the several exchanges below.

1. **Jerome**: I feel that once you take the temperature before, at every stop, and then at the end; then we’ll have it.
2. **Amy**: All right. So can I still type?
Table 15

Amy and Jerome's field trip conversation

<table>
<thead>
<tr>
<th>Line number</th>
<th>Message unit</th>
<th>Contextualization cue (CC)</th>
<th>Conversation strategies</th>
<th>Loc. of Know.</th>
<th>Conversation Strategies</th>
<th>Loc. of Know.</th>
<th>Argument Codes</th>
<th>Interaction units (lines)</th>
<th>Social interaction</th>
<th>Linguistic evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>For our question, we're trying to find the oxygen levels.</td>
<td>Looking at Jerome; longer drawled “e” on levels</td>
<td>Response</td>
<td>Amy</td>
<td>Focusing</td>
<td>Amy</td>
<td>NA</td>
<td>1-14</td>
<td>Jerome</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>2</td>
<td>So how would you set up the question?</td>
<td>Looking at Jerome; raised intonation at question</td>
<td>Question</td>
<td>Jerome</td>
<td>Clarifying</td>
<td>Amy</td>
<td>NA</td>
<td>1-14</td>
<td>Jerome</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>3</td>
<td>Restate your question because it wasn’t clear</td>
<td>Looking at laptop screen; flat intonation throughout</td>
<td>Response</td>
<td>Amy</td>
<td>Clarification</td>
<td>Amy</td>
<td>NA</td>
<td>1-14</td>
<td>Amy</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>4</td>
<td>OK</td>
<td>Looking at Jerome; flat intonation</td>
<td>Response</td>
<td>Amy</td>
<td>Confirming (+)</td>
<td>Amy</td>
<td>NA</td>
<td>1-14</td>
<td>Jerome</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>5</td>
<td>So like the writing part of the whole entire lab</td>
<td>Talking quickly while looking at Jerome; pause after lab</td>
<td>Response</td>
<td>Amy</td>
<td>Clarifying/restating</td>
<td>Amy</td>
<td>NA</td>
<td>1-14</td>
<td>Jerome</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>6</td>
<td>We need to come up with a question</td>
<td>Talking quickly while looking at Jerome</td>
<td>Response</td>
<td>Amy</td>
<td>Clarifying/restating</td>
<td>Amy</td>
<td>NA</td>
<td>1-14</td>
<td>Jerome</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>Line number</td>
<td>Message unit</td>
<td>Contextualization cue (CC)</td>
<td>Conversation strategies</td>
<td>Loc. of Know.</td>
<td>Conversation strategies</td>
<td>Loc. of Know.</td>
<td>Argument codes</td>
<td>Interaction units (lines)</td>
<td>Social interaction</td>
<td>Linguistic evidence</td>
</tr>
<tr>
<td>-------------</td>
<td>--------------</td>
<td>----------------------------</td>
<td>-------------------------</td>
<td>--------------</td>
<td>-------------------------</td>
<td>--------------</td>
<td>----------------</td>
<td>----------------------</td>
<td>------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>7</td>
<td>A thesis†</td>
<td>Looking at Jame; raised intonation at “thesis”</td>
<td>Response</td>
<td>Amy</td>
<td>Clarifying</td>
<td>Amy</td>
<td>NA</td>
<td>1-14</td>
<td>Amy</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>8</td>
<td>No</td>
<td>Looking at Jerom; flat intonation with word</td>
<td>Response</td>
<td>Amy</td>
<td>Confirming (-)</td>
<td>Amy</td>
<td>NA</td>
<td>1-14</td>
<td>Jerome</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>9</td>
<td>You mean the question that we’re answering†</td>
<td>Raised intonation at answering; looking with eyebrows raised at Amy</td>
<td>Question</td>
<td>Amy</td>
<td>Clarifying</td>
<td>Amy</td>
<td>NA</td>
<td>1-14</td>
<td>Amy</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>10</td>
<td>What is the question†</td>
<td>Raised intonation at question while looking at Jerome</td>
<td>Response</td>
<td>Amy</td>
<td>Clarifying</td>
<td>Amy</td>
<td>NA</td>
<td>1-14</td>
<td>Jerome</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>11</td>
<td>What is the effect†</td>
<td>Raised intonation at effect; looking on laptop screen in front of him and looking at Amy’s paper</td>
<td>Question</td>
<td>Jerome</td>
<td>Clarifying</td>
<td>Jerome</td>
<td>NA</td>
<td>1-14</td>
<td>Amy</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>12</td>
<td>What is the effect of stream flow on dissolved oxygen levels†</td>
<td>Raised intonation at effect; looking on laptop screen in front of him and looking at Amy’s paper</td>
<td>Question</td>
<td>Jerome</td>
<td>Extending/clarifying</td>
<td>Jerome</td>
<td>NA</td>
<td>1-14</td>
<td>Amy</td>
<td>Ccs and content of message unit</td>
</tr>
</tbody>
</table>
Table 15 – Continued

<table>
<thead>
<tr>
<th>Line number</th>
<th>Message unit</th>
<th>Contextualization cue (CC)</th>
<th>Conversation strategies</th>
<th>Loc. of Know.</th>
<th>Conversation strategies</th>
<th>Loc. of Know.</th>
<th>Argument codes</th>
<th>Interaction units (lines)</th>
<th>Social interaction</th>
<th>Linguistic evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>Stream flow↑</td>
<td>Looking and writing on her paper; raised intonation</td>
<td>Question</td>
<td>Jerome</td>
<td>Clarifying</td>
<td>Jerome</td>
<td>NA</td>
<td>1-14</td>
<td>Jerome</td>
<td>Ccs and content of message unit</td>
</tr>
<tr>
<td>14</td>
<td>Stream flow on oxygen levels</td>
<td>Looking at computer screen while talking to Amy; flat intonation in words</td>
<td>Response</td>
<td>Jerome</td>
<td>Clarifying</td>
<td>Jerome</td>
<td>NA</td>
<td>1-14</td>
<td>Amy</td>
<td>Ccs and content of message unit</td>
</tr>
</tbody>
</table>

*Note.* Loc. of Knowledge means the location of knowledge of the message unit.
In another example, Amy and Jerome are discussing tools needed for their field trip.

1. Amy: Oh are we going to need that CO₂...like Oxygen, Oxygenator something?
2. Jerome: What is the name of the tool used to measure O₂ levels in water.
3. Mr J: Oxygenator.
5. Amy: I was right.

---

**Figure 18** Purpose of Amy and Jerome's field trip experiment

**Figure 19** Data collected during Amy and Jerome's experiment
1. Amy: I don't know why I'm just thinking of the moon and you, like that. We're gonna do something with the oxygen levels.
2. Jerome: Yeah. Speed of the string on dissolved oxygen levels.
3. Amy: Yeah, smart right? Is there anything else we need?
4. Jerome: Meter stick, right?

In terms of the presentation, however, Amy and Jerome did not make any further connections between their findings and their claim (see Figure 19). They did not provide any written evidence for the stream velocity on the presentation. Instead, Jerome and Amy played a clip where Jerome recalled the stream velocity of one station with the corresponding oxygen level. Because of the unfortunate circumstances of the field trip itself, Jerome and Amy were not able to collect measurements from several stops which thwarted their plans for their study. Still, with the data that they did have, they were not able to use it as evidence with an explicit statement that included their rationale for using any data in their study.

As seen in this section, the APES participants had various degrees of incomplete arguments when instruction was not explicit in classroom assignments. Participants used clarification strategies in classroom discussion regarding argument-based cased studies (Green & Wallat, 1981). In written arguments, APES students were incomplete, focusing on extending and raising strategies for claims with lack of evidence and/or reasoning. However, clearer instruction from the teacher showed that students could potentially create constructed arguments.

4.2.4 Section summary

Overall, the ways that participants engaged in argumentation were somewhat correlated to the type of classroom activities and teacher instruction. RES students had
instruction that was more formal, with clearer teacher instructions describing the need for rationale, substantiated claims, etc. APES students had more flexible teacher instruction, and evidence showed that explicit instruction of argumentation for participants resulted in clearer constructed arguments. Still, RES and APES students used argumentation structures that varied from the use of only claims to completed arguments. This study also showed that group dynamics played a significant role in the construction of arguments, with different perspectives offering various components of a complete argument. RES and APES students also used extending and restating strategies for emphasizing claims and rebuttals but often missed opportunities to use reasoning. When reasoning did occur, it was typically of a rationalistic type. APES students in whole classroom and small group discussions often used clarification strategies by requesting clarification of content work and activities and had instances of thematic shifts in discussions. The trait of caring manifested itself with participants discussing the lack of caring or via linguistic evidence that aided in these themes permeating an argument in an implicit manner. In the evaluation of arguments, participants focused on the environment, but various aspects of it (i.e., the general ecosystem and people). Lived experiences presented in this section focused on two RES participants, Bailey and Brandy who offered differing viewpoints on the economy. The use of lived experiences are further explored in section 4.3.

4.3 Lived Experiences

Lived experiences did surface during the course of the study and were apparent for some participants. These unequivocal lived experiences were apparent because the participants made the cognitive connection between their arguments and their lives either
in the classroom or in interviews. The general group of lived experiences was further
delineated into the types of lived experiences that arose. For instance, examples of such
themes were the love for the environment as well as themes relating to race and
economics (i.e., finances and jobs) for one participant. Economics, crime, and traffic
safety were patterns that arose from another participant. And for one APES participant,
Amber, education arose in her lived experiences. To a lesser extent, lived experiences
were found for Maya, an RES participant, who realized that a topic, elephant tusks,
related to the statues in her grandmother’s house. However, this experience is discussed
more fully in a subsequent section regarding the personal relevancy of these topics and
will not be discussed further here.

The use of lived experiences also occurred in various approaches of
argumentation for RES participants, Bailey and Brandy and APES participant, Amber.
Amber and Bailey used these experiences in the construction of their arguments. Brandy
used hers in the evaluation of arguments. The other participants (both in RES and APES)
did not use lived experiences during my observations nor did they make connections in
the interview.

4.3.1 Bailey- love for environment, race, job, and economics

Bailey lives with her mother who raises both her and Bailey’s 10-year old sister
alone in an urban neighborhood close to Riverwest. She commutes each day because her
mother insists she not remain in the urban schools located in her neighborhood due to the
less challenging academic curricula. Aside from track, she has a job where she
specifically works to help pay for college the following year. As mentioned previously,
she is also looking forward to an athletic/academic scholarship that will help offset the
expensive school costs. Despite the obvious love she has for her hard-working mother, she still admits that she is not close to her, because she is “always working, and she's a single mom, so like, I barely see her.” However, her mother is also environmentally conscious. In actuality, her mom signed Bailey up to attend a local environmental school when Bailey was five years old and attempts to incorporate environmentally-friendly food into their diet at every opportunity. Bailey’s mother’s strong environmental influence in her life manifested several times during the course of the argumentation-based activities in my study. I have already presented a previous example of Bailey mentioning to her fellow county commissioners that she attended environmental school, as seen below.

1. Bailey: It’s good and bad opportunities. Yeah, I mean it is job opportunities.
2. for the...if you build the park?
3. Katie: Yeah, but then it’s also like, it’s like…who’s it going to benefit?
5. Bailey talks at the same time as Adam and it is inaudible.
6. Bailey: Yeah, ‘cause...I don’t know about, like, if I could actually work out there. I mean I went to environmental school when I was in Montessori and
7. elementary school. I mean, I liked it, but I wouldn’t want to be there every 9. day or anything as a job.

Here, one can see that Bailey’s old school’s influence on her perspectives gave her pause when evaluating the Friends of Nature group during the town hall simulation. She found that she appreciated the sentiment of protecting the preserve after recalling her old environmental teacher’s remark on the carelessness of others when it came to taking care of our planet. However, her economic sensibilities did not understand the need to waste the land.

Bailey also discussed organic vegetables as a way to offset the consequences of global warming with her small group. The passage below is the extended version of a part
of the transcript that was discussed in the caring section, where Bailey and her group
discuss African-Americans and Mexicans buying organic vegetables.

1. Xavier: We have to care more about this earth (crosstalk).
3. Xavier: I know.
4. Bailey: My mom be buying that stuff. That stuff tastes so much better.
5. Strawberries and stuff, they taste so much better.
6. Xavier: They do?
7. Bailey: Yeah, and it lasts longer. Without using pesticides and stuff?
8. Xavier: Why do they do it? They do it to make them last longer, you lying.
9. Bailey: Pesticides… (Gives Xavier a confused look)
10. Xavier: They put all the stuff in there to make them grow quicker and last
11. longer.
13. Xavier: They do. Don’t they?
14. Bailey: We just said not when it’s…their organically grown.
15. Xavier: Not when you’re growing organically. I bet they put preservatives and
16. stuff in there, to grow faster.
17. Adam: Not when it's organic.
19. Xavier: I doubt that. I thought when they put that stuff in there, they try to
20. make it last longer.
21. Bailey: Yeah, but, If you go to Makers [pseudonym for grocery store] and you
22. look at the strawberries that are regular and their size and stuff and you look at
23. the organic strawberries and they’re completely different. I know, ‘cause my
24. Mom, she’s weird…and she eats all that stuff.
25. Adam: They got to make it more affordable for the normal person.
26. Bailey: Yeah, I know…cuz I talked about…cuz I went to an environmental
27. science school, um, middle school, and elementary and middle school
28. environmental science.
29. Xavier: Okay, keep going.

In the above passage, Bailey’s group argued about pesticides while constructing a formal
argument on the balancing of environmental and economic needs. Besides this, lines 4,
21, and 26 demonstrate the inclusion of her own lived experiences as she discussed her
mother’s shopping habits as well as her old school to reconcile arguments about being
environmentally friendly. Again, Bailey emphasizes her lived experiences as it relates to
how she perceives the economy and finance. Please see Figure 20 for the map I
constructed to highlight an interaction unit that begins in line 29 between Bailey and Xavier. In this table, one can also see how the lived experience relates to Bailey’s racial group identity and science identity as a student. Identity will be further explored in the upcoming section but has an inextricable connection to lived experiences.

<table>
<thead>
<tr>
<th>Message Unit</th>
<th>Lived Experience within the Narrative</th>
<th>Social Identity Within the Story Telling Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xavier: Okay, keep going</td>
<td>NA</td>
<td>Reporter</td>
</tr>
<tr>
<td>… We were talking about that kind of stuff</td>
<td>Bailey enacting younger experience in school science</td>
<td></td>
</tr>
<tr>
<td>She [the teacher] was basically saying</td>
<td></td>
<td></td>
</tr>
<tr>
<td>how African-Americans, Mexicans can’t really afford…stuff like that.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>That’s why they buy, like the regular stuff.</td>
<td>Bailey enacting racial identity within academic experience/ emphasis on economy (i.e. finances)</td>
<td></td>
</tr>
<tr>
<td>Don’t nobody wanna buy organic stuff because it costs too much.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Figure 20 Lived experience map for Bailey*

**4.3.2 Brandy – economy and the concerned resident**

Brandy is a 17-year old senior who commutes to Riverwest from her downtown home each day. She commutes for the same reason as Bailey does, better academic opportunities and more challenging curricula. To provide some context to Brandy’s life,
here is her comparison of Riverwest versus the urban Rockyville School District in the passage below.

I like it[intellectual challenge of Riverwest] like that because if I would have went to Crestonville (pseudonym for old urban school), I feel like I would have just been like everybody else. I’m not a slacker. I like to have straight As and Bs. I was a 4.0 student my whooole life. And I came here and, like, Rockyville Schools, it was like cutting cake. And then when I got here, it was just completely different. Like, here, they actually teach you. I feel like, in Rockyville, you just go to school. You think you’re learning, but you’re just going to school, really. So, here, it’s a little more tougher and challenge me more but I like it better.

Brandy has significant responsibilities as one of five children to a single mom. She lives in a close-knit predominantly Mexican community located in downtown Rockyville, an urban area near Riverwest. There, she has formed close relationships with the Mexican community. She states, “[Mexicans] get along well with Black people because I guess they consider themselves African-American.”

Brandy’s use of her lived experiences were discussed in the interview where she recalled evaluating the background information for the town hall simulation as well as listening to the arguments from the various special interest groups. When reading about the construction of the lumber mill, she said that this reminded her of the construction of a local dollar store in her neighborhood.

I just feel like they should have looked at more of the people’s shoes that live in that neighborhood. They’re so use to peace and quiet, and now you’re just bringing in all this chaos. Like, that’s just going to affect them greatly. I can kind of relate to that, because where I live, it’s kind of like peace and quiet. But now they just built this huge Happy Dollar over there. So now it’s, like, a lot of traffic and it’s just crazy. I don’t understand why they ever did that. ‘Cause it’s just too much traffic. And it’s like, a lot of kids in that area, ‘cause it’s an elementary school over there? And with all that traffic, like, kids are getting hit by cars and some kids…kids are more likely to get kidnapped now and they’re just trying to walk to the store.
Brandy stated that this event along with a personal experience where a friend’s small daughter was almost kidnapped walking down the street of a neighborhood swayed her judgment to not construct the lumber mill. Here, one can see that Brandy also includes an element related to the economy as Bailey does. In Bailey’s case, however, she uses economy and finances from a perspective in which it is primary. However, Brandy includes economy (the addition of a new store in the neighborhood) secondary only to safety and crime brought on by traffic.

In addition, Brandy did not mention these concerns during the actual town hall simulation. Instead, Brandy asked the Chamber of Commerce questions that were not related to the consequences of increased traffic. These questions were, “What are you going to do with the trees when you cut them down?” or “How are you going to control the fishing?” Such an event may support the notion that teachers should encourage the use of lived experiences in the classroom before and after argumentation-based activities as a way to scaffold their understanding of argumentation into relevant ways associated with their own lives. This will be further discussed in Chapter 5. However, in a social map that allowed for a deeper analysis of this passage (Figure 21), it is clear that Brandy connected her lived experiences as a concerned resident, aunt, and sister to the town hall simulation in Mr. J.’s class.

4.3.3 Amber – the place of education

Amber was the only participant that came from a two-parent home. She described her family with love, particularly her mom, who she states, “is in my corner all the time.” Amber was another participant – like Brandy – who discussed her lived experiences in the interview, but still used those experiences to help construct written claims that were
assigned in class. In a previous section, I presented one aspect of the interview in which she described her 5-year-old brother’s experience at the zoo.

<table>
<thead>
<tr>
<th>Message Unit</th>
<th>Lived Experience within the Narrative</th>
<th>Social Identity Within the Story Telling Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brandy: I just feel like they should have looked at more of the people’s shoes that live in that neighborhood.</td>
<td>NA</td>
<td>Reporter</td>
</tr>
<tr>
<td>They’re so use to peace and quiet and now you’re just bringing in all this CHAOS.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Like, that’s just going to affect them greatly</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can kind of relate to that, because where I live,</td>
<td>Brandy enacting identity of resident of her community (economics vs. safety)</td>
<td></td>
</tr>
<tr>
<td>it’s kind of like peace and quiet but now they just built this huge Family Dollar over there,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>so now it’s like a lot of traffic and it’s just crazy.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I don’t understand why they ever did that.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>‘Cause it’s just too much traffic.</td>
<td>Brandy acting as resident and concerned family member (aunt, sister)</td>
<td></td>
</tr>
<tr>
<td>And it’s like, a lot of kids in that area ‘cause it’s an elementary school over there? …</td>
<td></td>
<td></td>
</tr>
<tr>
<td>And with all that traffic, like, kids are getting hit by cars and some kids</td>
<td></td>
<td></td>
</tr>
<tr>
<td>kids are more likely to get kidnapped now and they’re just trying to walk to the store.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Figure 21* Lived experience map for Brandy

Zoos, you look at the animal. You think it's cool. You see little kids, like 2-year-olds. My brother, he's 5. He doesn't want to learn at the zoo, because he's not at the age to learn. He's at the age to look at the tiger and know it's orange and black. You know what I mean?

Later, Amber mentioned,

There's plaques at zoos in front of the animals. They have facts that are important, but if you want to...you don't go to the zoo to be, like, okay, let's learn *(claim)*.
You go to the zoo to look at the animals, and get a little of the facts. If you want to learn about the animal, then go to a wildlife center – where I went before to learn about some owls. Owls scare me. They really do. They look at you with those piercing eyes.

As evident in the preceding passage, Amber added her own experiences of visiting a wildlife center in order to help provide rationale for her argument over the purpose of zoos.

4.3.4 Section summary

The use of lived experiences unequivocally occurred for four of the participants in my study. It differed in the types of themes of the participants. These experiences were associated to themes of the economy and the environment, albeit in various means of priorities. Themes of crime, race, education, and traffic safety were also found. Lived experiences also differed in the approach used, with participants using these experiences in the construction of the argument as well as in the evaluation of these arguments. Lived experiences were not limited to the specific arguments themselves. Participants’ lived experiences also manifested within the social context of the argumentation-based activities. In this regard, there were various themes and patterns found in the video segments that could be coded accurately once segments were transferred to the MAXQDA 10 program. This is shown in section 4.4.

4.4 Cultural and Psycho-Social “Gate-keepers”

Upon my encounter with Darlene, I shifted my lens from viewing lived experiences solely in relation to the argument itself to also including lived experiences of the participants as it related to the social context of the argumentation activity. For this study, the social context is defined as the classroom and/or school environment in which
these activities are taking place. In shifting this lens, themes and patterns arose that were easily captured using MAXQDA 10 once I transferred the selected transcribed video segments and field notes onto this program. Please see Table 16 for a list of these themes. Consequently, this provided a detailed view of the classroom dynamics that occurred while participants engaged in argumentation. I will now highlight several factors, providing examples and evidence of the various nuances of dynamics that occurred for these students.

4.4.1 Psyco-socio-cultural factors

4.4.1.1 Resistance and compliance to structural barriers

There were two general types of structural barriers based on geographical location that remained prominent in my study. These were a resistance to the structural barrier of the urban school for those participants that attended Riverwest despite having a high school in their urban neighborhood and resistance/compliance to Riverwest itself.

4.4.1.2 Resistance to the structural barrier of the urban school

Four of my participants, Brandy, Bailey, and Darlene, experienced a resistance to the structural barrier of the urban school as shown in the interviews. All of these participants live in urban neighborhoods with their own urban schools. All of the participants went to these schools before attending Riverwest. Consequently, all of these students stated that their mothers did not want them to keep attending these schools due to the lack of curricular and pedagogical resources. Below, several statements are
presented to demonstrate the feelings of Brandy, Bailey, and Darlene in regards to their former schools.

**Brandy:** So around there, the schools are just like, kids are just there because they have to be there. They’re not like really learning, like there are only a handful of kids that graduated and my mom just didn’t want me to go there.

**Bailey:** …And my mom wanted me to get out of Northeastern because it was too easy.

**Darlene:** They [neighborhood urban school] were two years behind us, so I was like, ‘I already learned this, so I don’t need to learn it again’. And I was cutting up at school, because I had nothing to do. Because I was already finished with my work a half an hour early.

I would be remiss if I did not mention that these statements are a very strong indicator of the dire need to revamp the urban schools in the area that surrounds this field site. However, this will be further explored in Chapter 5.

**4.4.1.3 Resistance to the structural barrier of Riverwest**

Although Brandy resisted the structural barrier of the urban school, doing so also meant that she struggled to resist the structural barrier of Riverwest as well. I first noticed this after seeing a pattern of Brandy being late to class approximately one-third of the time. When she did arrive, she looked groggy. I noted that this was a first hour class, but I was really curious when I noted that she was the only one out of the whole class that was consistently late. In the interviews, Brandy, a self-proclaimed good student with a 3.0 GPA, confided in me that one of the difficulties she had in getting to school was the struggle she faced with her own nightly duties as an aunt or second mom to her sister’s two kids: a 5-year-old boy and an 8-year-old girl. As another “mom” to these children, she said that she has helped raise her niece and nephew ever since her sister had her first
Table 16
Psycho/socio-cultural and pedagogical factors for participants

<table>
<thead>
<tr>
<th>Psycho-socio-cultural factors</th>
<th>Pedagogical Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Resistance/Compliance of structural barriers (school)</td>
<td>• Engagement of topic</td>
</tr>
<tr>
<td>• Individual challenges/ coping strategies (i.e.</td>
<td>• Academic discursive challenges (teacher-student discourse challenges, science discourse)</td>
</tr>
<tr>
<td>mental/emotional health, learning disabilities)</td>
<td>• Misunderstanding of assignments (confusion of CER model with scientific method)</td>
</tr>
<tr>
<td>• Internal group dynamics</td>
<td>• Pedagogical/curricular organization</td>
</tr>
<tr>
<td>- Individual social behaviors (i.e. silence, verbosity, etc.)</td>
<td></td>
</tr>
<tr>
<td>- Linguistic challenges</td>
<td></td>
</tr>
<tr>
<td>- Similar academic interest</td>
<td></td>
</tr>
<tr>
<td>- Group member affinity (racial-makeup, similar belief systems)</td>
<td></td>
</tr>
<tr>
<td>• Coping strategies</td>
<td></td>
</tr>
</tbody>
</table>
child at the age of 16. Brandy typically comes home from her own after-school job which she has because, “It’s easier on my mom, ‘cause she has five kids. And for us to all have our hand out to her…that’s like…that’s stressful for her.”

During this time, her sister drops off the kids and Brandy watches them all night as her sister works her third shift job. Although this does not seem as if it is too laborious, her nephew also has attention-defecit hyperactivitiy disorder (ADHD) and does not sleep well at night. After listening to her count the number of ways that she attempts to calm her nephew down at night (e.g., giving a calming bath, playing outside for awhile, etc.), I realized that she loved her nephew very much and really seemed to believe she was like a second mother to him. However, it was taking a toll on her, and affected her ability to come to school on time. Besides having a longer commute to Riverwest from her own urban neighborhood, she also had the compounded responsibilities of dropping off her little sister to her school before reaching Riverwest.

Brandy’s lived experiences as a daughter, sister, aunt/second mother are important to consider in this study, because Brandy would miss out on certain important argumentation-based activities. Her attempt to resist this structural barrier caused some tension one day when she came in late again at the tail end of an important small group discussion.

1. Lynda signals to Mr. J. She’s here (indicating Brandy), so I don’t know what 2. you want us to… 3. Mr. J.: She can join with you guys. 4. Lynda: (informing Brandy) OK, so we’re just kind of talking about, we’re just 5. doing. Well, we’re almost done. You don’t have anything to worry about it. 6. Brandy: Are you finishing this stuff from the movies? 7. Hannah: OK, so what are the ways that we can decrease global warming? 8. Recycle? 9. Lynda: Recycle…ummm. 10. Hannah: Not driving as much….
11. **Lynda**: Carpooling.
12. **Hannah**: Anything else?
13. **Lynda**: Not that I can think of.
14. **Hannah**: And pretty much throwing away their trash in the right places.
15. **Lynda**: Yeah.
16. **Hannah writes this down. She starts reading.** What challenges do you think we might have to face? What challenges would we face, what problems would we face?
17. **Lynda**: I’m not sure.
18. **Hannah**: The challenges we would face are…other people’s opinions. *Writes that down. OK, show that to them.*
19. **Lynda**: He wants us to present this (after *coming back and talking to Mr. J.*)
20. **Hannah**: He wants us to present this? Awww…word! (*sounding happy*) Can we put this on a big poster board then? I’ll write it on the board. So it won’t be hard to present, so we won’t be reading off a piece of paper.
21. **Lynda**: Have Brandy read it.
22. **Hannah**: I’m going to buy a really big poster and we can just ask Mr. J.
23. **Lynda**: He’s coming…Lynda. My neck hurts so much right now.
24. **Hannah**: You should probably right your name on this (*to Brandy*).

From the video segment, Brandy provided contextualization cues that showed she attempted to engage in the discussion. She grabbed her papers and attempted to read the questions and responses even after Lynda assured her that it is not necessary for her to contribute. Eventually, she chose to remain quiet and resigned to have the group, particularly Hannah and Lynda, finish the assignment. In this passage, one may see that the rest of the group essentially led by Hannah and Lynda wish to hurriedly complete their task despite Brandy coming in to join them. Lynda also volunteered Brandy to present the information the following day to make up for the fact that she was late to the group (line 26). In an interview, Brandy explained her feelings about this discussion.

‘Cause when I came in, they were just scribbling them down. And I was just trying to hurry and read them before I left for Freshman campus. And I’m just like trying to read them before we present them? And I just want to make sure whatever your answer to the question, we’re going to be able to just run off of them. That’s just going to be something to give us pointers. And I don’t know, I just felt lost with the whole group.
The easiest resolution to this conflict may be to encourage Brandy to get up earlier in the morning to arrive to school on time. However, such a simplistic solution removes the various responsibilities of students and teachers in classrooms of ensuring that everyone understands what is taking place during an activity. Enforcing formal rules that small groups must follow are simple pedagogical changes that could have effectively helped Brandy contribute to the discussion and not feel as if she is an outsider.

4.4.1.4 Compliance to structural barrier of Riverwest

April showed compliance to the structural barrier of Riverwest when it came to her choice of choosing classes that would fit her academic needs yet make her feel comfortable as a Black student. April’s start at Riverwest is indeed unique because she first attended Riverwest in the 10th grade and subsequently left after the first day. When she first attended, school officials found that she was very intelligent and placed her in AP classes as a way to keep her consistently challenged. April describes her experience.

Aaaannd...with my grades and stuff I was able to take AP classes. And I just felt as if, um, they thought I wasn’t smart enough to be in there, when I proved by my grades I was smart enough to be in there. But that doesn’t matter. I dropped all of them, and just stick to regular classes instead. The people in there are, you know, regular people (laughing). In AP, you try and strive to be the best. Better than everybody else and it’s just... Ima [sic] just be a best instead of the best. You know what I’m saying?

As viewed in the preceding passage, April said that the treatment she received at the time from her class, where most of the students were predominantly White, seemed to reflect a disbelief from these students that she was capable of attending these classes because she was Black. April felt so uncomfortable that she left Riverwest after one day and attended her old school for the remainder of the year. Upon returning during her junior year, she opted to avoid those same experiences by picking regular classes which she enjoys.
Although April is happier, she chose to change her own behavior in response to the racist experiences that she received, something that could lead to missed opportunities for more challenging and stimulating curricula that would better fit her intelligence. April’s response to these events often belied her view of togetherness and collectivity in the actual construction of her arguments (i.e., global warming). These institutional factors have been discussed in literature (Weber, 2001; Zambrana & MacDonald, 2009) and will be explored in Chapter 5.

4.4.1.5 Individual challenges/coping strategies

4.4.1.5.1 Darlene and her special needs.

Analytic Memo from October 17: I’m sort of blown away. When I asked Mr. J. where Darlene was, (after not seeing her in class for a few days), Mr. J. confided that Darlene was in her fourth day of taking an exam because she needs the time. I don’t know why I’m shocked. I do this all the time with my own college students who have special needs, but it’s college! It’s much easier to be flexible with a college schedule. After seeing all the material Mr. J. has covered in the last few days and noticing that Darlene is not here, how does she handle it?

One participant in my study that showed clear challenges in school but worked to conquer these strategies was Darlene.

Darlene: I have OCD.
Phyllis: Have you went to the doctor and they said it or...?
Darlene: I don’t believe they said it. I think my Mom was just like, ‘You have got OCD. You wash your hands constantly.’
Phyllis: How long do you think that has been going on?
Darlene: Ever since I was little. Ever since I was little, my Mom was always yelling at me for running water. And I would be really washing my hands so it was really weird.
Phyllis: What’s little? How old were you?
Darlene: Little is 5.
Phyllis: 5?
Darlene: Yeah. I remember washing my hands, and my Grandma came in the room and was like, ‘What are you doing?’ I’m like, ‘I'm washing my hands. My hands are dirty.’ She goes like, ‘You are peeling your skin off of your hands.’ I’m
like, ‘No, I'm not, they're dirty, they're dirty.’ And I was doing that every morning. I wash my hands a few times every morning, plus I have the hand sanitizer so ... 

**Phyllis:** You are doing it basically every... and I see the hand sanitizer in your backpack?  

**Darlene:** Yeah, I can't ...  

**Phyllis:** How does that affect you being in the environmental science class?  

**Darlene:** I don't know. After every, after I would get to my second hour, I will ask the teacher to go and wash my hands, and I will use some hand sanitizer and everything. I always do it in between class. I have taught myself not to leave class to do it. That's why I have hand sanitizer and it's so low right now, so I have to go and get some more.

In the preceding passage, Darlene gave a detailed account of her issues with cleanliness and also shows how she copes with this in school so as not to interfere with her classwork. Besides this, Darlene also had special considerations in taking exams because reading material may seem overwhelming for her. Because of this (as mentioned before), Darlene missed out on class. Her extended absences only directly impacted one argumentation activity in the classroom (a case study). I asked her how this overall impacts her classwork at Riverwest.

**Darlene:** I always come back for my work. I'm always in his face about... I'm like, ‘Can I have my work? Can I have my work?’  

**Phyllis:** This is with all your classes too? Every one is like, willing to just hurry up and support you?  

**Darlene:** Yeah.

4.4.1.5.2 Amber, Kylie, and canoeing.

Amber and Kylie also showed coping strategies when faced with the challenge of canoeing down a large Midwestern river without knowing how to swim. On the morning of the trip, Amber made her feelings known to me as we waited to get in our cars to head to the river. She expressed anxiety and asked, “Aren’t you scared to get in a canoe?” several times. Upon our arrival, she admitted that people in her car (including Kylie) had read scripture and prayed for protection on the trip. For awhile, Mr. J. and I paired our
canoe with Amber and Kylie’s as we headed down the river since both girls were frightened. However, this experience was also coded as an *individual challenge* because Amber insisted that despite her fear, pairing up to their canoe was unnecessary because she wanted to “make [her] own mistakes” and “figure it out” on her own.

I get irritated fast. I don't want ... I like to do stuff on my own. I'm so independent. I can be by myself all day and be fine. I didn't like having Mr. J holding on to our boat, because everybody else was above us – ahead of us. They're not being ... We're not here to be with the teacher. We're on this trip to do our project. We're on the trip to learn a new experience, and I've never been canoeing. I've been white-water rafting; never been canoeing. I wanted to experience it. I can't be mad at her [Kylie] for being scared of the water, but I would not partner up with her again if we were to go on that trip. Because I wanted to have a full experience.

Kylie considers herself a religious person. She discussed her reading scripture and use of songs in the car on their way to the field trip.

**Kylie:** It was umm, it was the, it was the I can do all things through Christ scripture in umm, the fear one.

**Phyllis:** Perfect love casts out fear?

**Kylie:** No, the one, umm, actually the one I had was (*names an unfamiliar religious song*) a song, or something like that.

**Phyllis:** Mm-hmm.

**Kylie:** Yeah that one and that, aah, proverb something. That's another one, I don't remember.

This strategy helped Kylie tremendously on this trip. However, her overall ambivalence towards environmental science still affected her attitude for this activity and others.

### 4.4.1.6 Internal group dynamics

**Individual social behaviors (i.e. silence, verbosity)**

In section 4.2, I touched upon several instances where certain groups and the ways they interacted influenced their construction and evaluation of the arguments.

These were apparent in several groups in the study. For example, Bailey’s typical group
with Xavier and Adam were marked with verbosity. Her verbose behavior with this group also seemed to be related to their ability to each contribute elements of their arguments during certain activities as found in a previous example and below.

1. Adam: Do you think their role is successful?
2. Xavier: No!
3. Bailey: Whatchu’ say?
4. Adam: Is it successful?
5. Xavier: Somewhat. Somewhat successful (claim).
6. Bailey: I…I…I…they not! (Bailey is strong in her response. But)
7. she is still smiling hard at Xavier (rebuttal).
8. Xavier: So they didn’t stop any people? They didn’t recover over 10 million dollars in elephant tusks (topical evidence)?
9. Adam (He is looking down): I ‘on know, I ‘on know…
10. Bailey: Yeah, the elephants… (agreeing to claim)
11. Adam: But they weren’t catching a tiger (rebuttal).
12. Xavier: But they tryin’ though. Give them some credit (rebuttal). Bailey
13. laughs.
15. Xavier: They play a small role but they can’t…they can’t do it all (claim).
16. Bailey: ‘Cause they’re ain’t enough people that care about the environment (extending claim).

In contrast, Bailey admitted that when placed in another group, her discomfort when dealing with individuals from another race prompted her to remain relatively quiet, hence having a similar racial-make up was a factor related to group affinity in her case. Other contextualization cues that served as Bailey’s individual social behaviors were expressed as this discomfort, (i.e., hands placed mainly underneath the table, reduced smiles, and choosing to talk mainly to one of her original tablemates, Adam). Bailey still maintained her argumentative stance in issues relating to the town hall simulation. She insisted that she could not fully understand the Friends of Nature position despite two members of her group expressing disbelief of her comprehension. Still, she remained relatively quiet when compared to her behavior with Adam, Xavier, and Jim, her original group members.
The group make-up manifested in various individual social behaviors for the participants. Besides Bailey described above, Maya, an extremely shy RES participant as confirmed in the interview, maintained contextualization cues and other linguistic evidence throughout my observation period that showed her discomfort of being in a group in general. These cues involved remaining silent while the other group members discussed answers, even when prompted as seen in this short statement when someone asked her.

1. **Anne:** Do you have anything (*to Maya*)?
2. **Maya:** On this?
3. **Anne:** Yeah.
4. **Maya:** What number are we on?
5. **Everyone:** Number one.
6. **Maya:** I wrote down the wrong thing for number one. So I don’t really have anything.

In Maya’s statement regarding not “having anything”, she attempted to adopt an identity of a non-participating student (Bloome et al., 2005). However, she did change into a raising strategy where she eventually contribute her answer to the group after reflecting (Green & Wallat, 1981). This was also shown when her fellow group members were deciding on who would present as she insisted that she was shy even though a group member confronted her with experiences in another class that Maya attended.

1. **Stephanie:** I don’t really want to do it. Why don’t you do it? (*looking at Maya* 2 *with a smile*).
2. **Maya:** No, I don’t want to do it. I’m, I’m shy.
3. **Stephanie:** Shy? You’re not shy, I’ve seen you in choir.
4. **Maya:** No…that’s because I’ve been there for a long time and I know everyone.

Later, when Maya was grouped with another participant, Brandy, the difference in demeanor for Maya was striking. This can be seen in this short exchange between Maya and Brandy as Maya walked in late during the town hall simulation prep.
1. **Brandy discussing with her group:** Ummmm, we can go with questions or concerns about it. Our statement is for it because it will give people jobs…
2. **Mr. J. interrupts and brings Maya to the table because she was not there the day before.**
3. **Brandy:** Hi Maya!
4. **Maya:** Hi Bra!
5. **Brandy:** Come join my crew.
6. **Brandy:** Hurry up, Maya. Chop, chop.
7. **Maya:** Okay. I’m sorry.
8. **Brandy:** I got my car today. I drove to school.
9. **Maya:** You what (looking and sounding surprised)?
10. **Brandy:** I got my car today. I drove to school.
11. **Maya:** AAH!!! (Maya shrieks in surprise) Really?!
12. **Brandy:** Maya, this is Javier. Javier, this is Maya.

Darlene, in her group with Janice and Brian, showed her own *individual social behaviors* of discomfort that typically translated to her also remaining silent in the group. Janice, Brian, and TJ usually teased each other and conversed with each other. As Janice insisted to me during her interview, “We been knowing each other.” Janice was referring to Brian and TJ, but not Darlene. Meanwhile, Darlene would check her phone and look around the room as if bored. In one example, Darlene looked exasperated when Brian and TJ teased Janice in hopes of having her present their discussion responses to the class. Darlene piped in, “I’ll do it”, but stayed relatively quiet nonetheless. When asked about these dynamics in the interview, Darlene presented these instances as someone who maintained an authoritative position in the group and not as a relatively silent participant – the code that I often gave her when I observed her.

**Phyllis:** You had your group members, you remember them, right?
**Darlene:** Oh God, yeah.
**Phyllis:** Okay. But first off, well, let's go into how was it working with them.
**Darlene:** They didn't want to do the work.
**Phyllis:** What do you mean by that?
**Darlene:** The guys, they were just like, ‘Oh, I'm not going to read. Oh, I'm not going to contribute.’ I'm like, ‘Well, you have to, so get it together because I'm not going to fail because of you.’
Phyllis: How did you...so it was just the guys that were acting like they didn't want to work?
Darlene: Yeah. Yeah
Phyllis: What did you mainly do in the group?
Darlene: I was looking at notes and trying to get the questions, but I couldn’t figure out this one question. Like, ‘Guys, just help. Just get this over with, and just help.’

When shown a video clip of her presentation regarding the *Planet in Peril* film

discussion, Darlene began to discuss one of her group members as found in the following passage.

Darlene: You know that guy with the red thing...he’s over there. I wanted to just hit him with that [white] board.
Phyllis: This one (pointing at Brian in the video)?
Darlene: Yeah, I wanted to hit him with that board so bad. He just wouldn’t work.
Phyllis: Was he just, he was just trying to talk about other things?
Darlene: Yeah. I'm like, ‘I don't want to do this as much as you don't want to do this. So let's just get this over this.’
Phyllis: Were you the only one that seemed frustrated in that group?
Darlene: She was too, she was too (pointing at Janice).
Phyllis: She was?
Darlene: Because she was writing everything down because I have horrible handwriting.
Phyllis: Yeah, I could tell that she was writing the things down, and so that, so I was like, "Well, maybe that's why she is not talking as much." But I really did hear the gentleman talk a lot so ...
Darlene: I was telling her what to write.
Phyllis: Were you just talking off to the side to her while they were doing their own thing at times?
Darlene:Yeah.
Phyllis: But you didn't...so it's safe to say that you didn't necessarily like working with them?
Darlene: No.

Darlene’s frustration translated into the presentation itself a couple of days later. She mainly spoke during the presentation, with Brian speaking once while Darlene took over the remaining five questions. She shuffled through her papers frantically at times trying to find the questions that her group had to answer. As she states, “Yeah, it was weird
because I didn't know the questions because we didn't write them down, obviously. And I was getting frustrated. I'm like, ‘Okay, this is a disaster. Can I just sit down now’?"

In contrast, when Darlene was chosen as a county commissioner for the town hall simulation, the linguistic evidence showed a confident and more comfortable student, one that spoke up more frequently than when in her original group, and one who essentially led the group into preparing themselves for the simulation by creating questions. Darlene stated, “I liked it because I had a better group and we were each willing to contribute.”

This aspect of the internal group dynamics highlights the role of group affinity as it relates to the group members having similar academic interests and similar belief systems as it relates to participating in the social practice of argumentation. In Darlene’s case, having members that wanted to achieve the common goal of preparing for the town hall simulation and evaluating arguments related to the fruitful ways they were able to engage with each other.

1. **Darlene:** We should, like, write down a list of questions.
2. **Betty:** Hmmm?
3. **Darlene:** Like, we should write down a list of questions.
4. **Betty:** Do you guys want to write down, like a list of questions we should ask?
5. **Wade:** Yeah.
6. **Darlene:** *(inaudible)*…want to just write it down on another piece?
7. **Betty:** I got the paper.
8. **Darlene:** These are our questions, right?
9. **Betty:** Yep.
10. **Darlene:** Yeah, we got the questions right here. We got questions paper.
11. **Wade:** Oh.
12. **Lauren:** So are we against it, not for it?
13. **Darlene:** Say, if we…you have a low budget, how would you build it?
14. **Betty:** Um…we could say…wait, when you guys read the article…did it say 15. the government was in it too?
16. **Wade:** The what?
17. **Betty:** The government was in it? Was it just the people against it?
18. **Wade:** It was just the people.
19. **Betty**: So, for the people that are for it…we could say, like, how do you guys plan on getting the government’s view on this….like how do you guys plan on having it step them…step in as well. (*Crosstalk among group members*)

20. **Wade**: Yeah.

21. **Betty**: What else could we ask?

22. **Darlene**: I mean, ‘cause they ARE chopping down a lot of trees. Chopping down all these trees…so we could also ask what they plan on doing with the trees?

23. **Betty**: OK, asking about the trees?

24. **Wade and Lauren**: Yeah.

**4.4.2 Pedagogical factors**

Because the pedagogical factors have been discussed at length in section 4.1. and will be discussed even further in section 4.6, I present Table 17 which provides the references in the dissertation that one may refer to with each corresponding factor.

Table 17

Pedagogical factors

<table>
<thead>
<tr>
<th>Factor</th>
<th>Bookmarked reference in dissertation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engagement of Topic</td>
<td>Amy and relevancy of topic in section 4.5; Appendix B; Kylie in interview (Engagement of topic in section 4.6)</td>
</tr>
<tr>
<td>Academic discursive challenges (teacher-student discourse challenges, science discourse)</td>
<td>APES students in 4.1; Darlene in interview; Appendix B</td>
</tr>
<tr>
<td>Misunderstanding of assignments (i.e. confusion of resources)</td>
<td>APES students in 4.1</td>
</tr>
<tr>
<td>Pedagogical/curricular organization</td>
<td>Section 4.1 and Section 4.6</td>
</tr>
</tbody>
</table>

**4.4.3 Section summary**

Evaluating the classroom dynamics of these girls by evaluating their lived experiences in the social context of the argumentation-based activity revealed psychosocial/cultural and pedagogical factors that served as potential gate-keepers for the participants in my study. For instance, participants showed both resistance and
compliance to structural barriers relating to their previous urban environments and Riverwest. These instances impacted the argumentation-based activities in Mr. J.’s classroom. In one case, the compliance to the structural barrier belied the participant’s collective identity when constructing arguments. Various characteristics of group dynamics such as group affinity played a role in the participation of the girls in this study. This group affinity manifested into individual social behaviors that varied based on the affinity to that group. A summary of pedagogical factors were presented in this study with references to other areas in the dissertation.

4.5 Identity Formation

4.5.1 Classroom identity assignments

As described in chapter 3, discourse analysis involving identity formation in the classroom included the creation of tables and maps that assessed the role of these students in the message units via videotaped observations (Bloome et al., 2005). These assignments were then transferred to MAXQDA 10 for ease of organization. With this software, these assignments were assessed along with other classroom observation and interview codes to establish the subsequent descriptions for this section. It is assumed that the assignments are based on argumentation-based activities. Please see Table 18 for a list of these assignments related to the identity, use of argumentation, and non-verbal behavior related specifically to the participants. Appendix D contains the full list of codes found from the observations and interviews.
Table 18

Identity assignments

<table>
<thead>
<tr>
<th>Student identity</th>
<th>Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participating (general-classwork)</td>
<td>All</td>
</tr>
<tr>
<td>Participating – (anxious)</td>
<td>Amber</td>
</tr>
<tr>
<td>Participating – working alone</td>
<td>Kylie</td>
</tr>
<tr>
<td>Participating seeking knowledge from student</td>
<td>Amber, Kylie</td>
</tr>
<tr>
<td>Participating seeking topical/content knowledge/clarification from teacher</td>
<td>Kylie, Amy, Amber</td>
</tr>
<tr>
<td>Participant in position of authority to others</td>
<td>Amber to Tyrell(?), Kylie to Darnell, Brandy to Maya</td>
</tr>
<tr>
<td>Participating clarifying to Black male</td>
<td>Bailey and Xavier</td>
</tr>
<tr>
<td>Participant clarifying to Black female</td>
<td>Amber to Kylie; Maya to Brandy</td>
</tr>
<tr>
<td>Participating clarifying to White female</td>
<td>Kylie, Amber, April</td>
</tr>
<tr>
<td>Non-participating Black female (when prompted)</td>
<td>Maya</td>
</tr>
<tr>
<td>Participating Black male seeking clarification from group</td>
<td>Adam</td>
</tr>
<tr>
<td>Participating Black male acting as authority/leader</td>
<td>Xavier, Ken</td>
</tr>
<tr>
<td>Participating Black male as son to Black female</td>
<td>Darnell to Kylie</td>
</tr>
<tr>
<td>Participating female student of color to group (with Black female student)</td>
<td>Vicki</td>
</tr>
<tr>
<td>Participating White female student asserting role as authority (with Black female in group)</td>
<td>Lori</td>
</tr>
<tr>
<td>Helpful to student (teacher, mother/helpful friend)</td>
<td>April, Kylie, Brandy</td>
</tr>
<tr>
<td>Helpful to teacher</td>
<td>Maya</td>
</tr>
<tr>
<td>Helpful to Black female</td>
<td>Amber, Brandy</td>
</tr>
<tr>
<td>Activity</td>
<td>Participant(s)</td>
</tr>
<tr>
<td>---------------------------------------------------</td>
<td>---------------------------------------</td>
</tr>
<tr>
<td>Helpful (to Black male student)</td>
<td>Kylie</td>
</tr>
<tr>
<td>Clarifying Black male to Black female</td>
<td>Xavier</td>
</tr>
<tr>
<td>Cooperating/agreeing Black male to female</td>
<td>Darnell and Kylie</td>
</tr>
<tr>
<td>Clarifying teacher to Black female</td>
<td>Amy</td>
</tr>
<tr>
<td>Comforting teacher to Black female</td>
<td>Amber</td>
</tr>
<tr>
<td>Informing teacher (with Black female)</td>
<td>Kylie</td>
</tr>
<tr>
<td>Acknowledging teacher (to Black female)</td>
<td>Kylie, Amber</td>
</tr>
<tr>
<td>Teacher facilitating discussion from Black female</td>
<td>Kylie</td>
</tr>
<tr>
<td>Teacher confirming correct answer to Black female</td>
<td>Maya</td>
</tr>
<tr>
<td><strong>Argumentation elements with student</strong></td>
<td></td>
</tr>
<tr>
<td>Participant offering clarification of claim</td>
<td>April</td>
</tr>
<tr>
<td>Participating offering incomplete rebuttal</td>
<td>April</td>
</tr>
<tr>
<td>Participating offering rebuttal</td>
<td>April, Darlene</td>
</tr>
<tr>
<td>Participating Black male student with claim with</td>
<td>Xavier (Bailey and Adam)</td>
</tr>
<tr>
<td>group (with Black female)</td>
<td></td>
</tr>
<tr>
<td>Participating Black male extending claim with Black female</td>
<td>Xavier to Bailey</td>
</tr>
<tr>
<td>Participating Black male giving rebuttal to Black female</td>
<td>Xavier to Bailey</td>
</tr>
<tr>
<td>Participating Black male with claim (with Black female)</td>
<td>Xavier and Bailey</td>
</tr>
<tr>
<td>Participating White female with rebuttal to group</td>
<td>Kylie</td>
</tr>
<tr>
<td>(with Black female)</td>
<td></td>
</tr>
<tr>
<td>Participating female student of color to group with Black female student (Burmese) offering claim</td>
<td>Vicki</td>
</tr>
</tbody>
</table>
### Table 18 – Continued

<table>
<thead>
<tr>
<th>Social identities</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Establishment of racial identity</td>
<td>Amy, Bailey</td>
<td></td>
</tr>
<tr>
<td>Establishment of familial identity (daughter)</td>
<td>Bailey</td>
<td></td>
</tr>
<tr>
<td>Black male establishing racial identity with Black female</td>
<td>Jerome (Amy)</td>
<td></td>
</tr>
<tr>
<td>Acting as friend</td>
<td>Janice, Bailey, Amber (chastising)</td>
<td></td>
</tr>
<tr>
<td>White female to Black female participant acting as friend/personal</td>
<td>Lori to Brandy</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Non-verbal behavior of participants</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Black female student laughing</td>
<td>Bailey, Amber, Kylie, April, and Janice</td>
<td></td>
</tr>
<tr>
<td>Black female student silent during argumentation activity (long)</td>
<td>Maya, Amy, Kylie, Amber, Janice, Darlene, Brandy</td>
<td></td>
</tr>
<tr>
<td>Black female student rolling eyes/bored/sleeping</td>
<td>Bailey, Janice, Darlene</td>
<td></td>
</tr>
<tr>
<td>Black female student occupied with other device/cell phone etc.</td>
<td>Bailey, Darlene, Maya, Brandy, Janice, Kylie, Amber</td>
<td></td>
</tr>
<tr>
<td>Black female looking for resource during argumentation activity</td>
<td>Amy, Brandy, Maya, Janice, Darlene, April, Bailey, Kylie, Amber</td>
<td></td>
</tr>
<tr>
<td>Black female looking at class (presentation)</td>
<td>All</td>
<td></td>
</tr>
<tr>
<td>Black female looking at teacher (class only)</td>
<td>All</td>
<td></td>
</tr>
<tr>
<td>Black female raising hands – obtaining attention from teacher</td>
<td>Amy, Kylie, Amber, Brandy, Maya, Bailey</td>
<td></td>
</tr>
</tbody>
</table>
4.5.2 Classroom science identity

4.5.2.1 Beliefs of environmental science

Previous literature emphasizes the importance of student beliefs regarding science as a strong component of identity formation (Carlone & Johnson, 2007). Consequently, several themes arose among the participants that captured their views of science and their views of their own roles in science during argumentation-based activities.

4.5.2.1.1 Appreciation for the nature of science.

History doesn't change. You can learn about it over and over again. It's still going to be, this war happened in this year. Science changes all the time. You get what I'm saying?

Amber, APES student, senior

Several themes arose that were associated with the nature of science (NOS) in this study. One example is the above quote from Amber who comments on the dynamic nature of science in an interview. Amber, a bright senior with a competitive ACT score (according to Mr. J.) was “recruited” into Mr. J.’s AP class because he “saw something in me.” Amber happily volunteered her beliefs of science during our discussions. Unbeknownst to her, some of these beliefs coincided with previous research into NOS (NGSS, 2013). At times, these characteristics seemed to intertwine with her own general appreciation for science. For instance, at one point she asserted, “Nobody really knows what's out there. You only know what people have discovered, but there's so much other stuff out there, that people have never seen. I think that's the mystery about science.” This is an example of a statement that Amber made with awe and that NGSS would correspond to a high school level of “basic [NOS] understandings” (NGSS, 2013, p. 4). It
is commensurable with the NOS premise that “scientific knowledge is open to revision in light of new evidence” (NGSS, 2013, p. 4). Interestingly, the NGSS also asserts the importance of scientific argumentation in light of this “new evidence” (NGSS, 2013, p. 4). In association with this understanding, it contends, “Scientific argumentation is a mode of logical discourse used to clarify the strength of relationships between ideas and evidence that may result in revision of an explanation” (NGSS, 2013, p. 5).

Amber offered additional insight regarding the field trip that reflected another basic understanding of NOS; one in which science is viewed as a human endeavor. Please see the quote below (NGSS, 2013).

The [field trip] hiccups make it fun, because nothing is just A to Z. Nothing is perfect. Nothing is going to happen without hiccups. It's life. If we didn't have any problems, nobody's boat overturned, nobody got mad when he fell in, it wouldn't be fun.

This adventurous component falls align with a middle school NOS understanding that NGSS emphasizes, one in which scientists must show a “tolerance of ambiguity” (NGSS, 2013, p. 6). Amber provided yet another example of this understanding with the next quote. This quote stemmed from my voiced observation that students were not able to complete collecting their data for the trip because of the various unexpected circumstances that occurred that day (e.g., overturned boats, citizens calling the police on the APES class, etc.).

But scientists don't have the opportunity to conduct everything they need. They don't get to say, ‘Well, we got everything we needed today.’ They have problems too – all the time. It only fit that we had problems. It only fit that we didn't all come back with all the facts we needed. Even if they're not working on the same thing, they could correlate it in the same way, or change their experiment completely, like we did.
During the field trip, Amber displayed contextualization cues that were commensurable with her expressed beliefs from the interview. She was an active participant on this day, displaying determination when navigating her canoe even though she was a novice at steering it. Included is a portion of the analytic memo I wrote after this trip.

For someone that was terrified of the water, Amber seemed a lot more composed than Kylie, who was also not shy at stating her terror of the water! Amber never complained even though she was upset. She never gave up in steering that canoe which she had a hard time mastering. I had a whole new appreciation for the poise she seemed to have on this trip. Analytic Memo, dated October 2, 2014

Additionally, Amber expressed her frustration when Mr. J. and I held on to their canoe in the beginning of the trip down the river to mainly appease her frightened partner, Kylie.

We're not here to be with the teacher. We're on this trip to do our project. We're on the trip to learn a new experience, and I've never been canoeing. I've been white-water rafting; never been canoeing. I wanted to experience it. I can't be mad at her [Kylie] for being scared of the water, but I would not partner up with her again if we were to go on that trip. Because I wanted to have a full experience.

Amber was absent during the day of her field trip presentation because she was visiting area colleges. Interestingly, these beliefs did not manifest in other argumentation-based activities throughout the study. Still, Amber made these statements when discussing the field trip, an activity considered argumentation-based for this study. Also, an appreciation of the nature of science constitutes an important part of science identity, as will be discussed in Chapter 5.

4.5.2.1.2The relevancy of environmental science/related to personal lives.

The relevancy (and lack of relevancy) of Mr. J.’s environmental science topics were discussed in interviews along with any related classroom observations. Because relevancy could very well be a subjective term – implying that the significance of a topic to one person may not be significant for another, it is important for me to clarify its use in
the context of this study. Initially, I felt that relevancy constituted the significance of various environmental science topics to the personal lives of these students. Included in these personal lives are their own lived experiences. However, in this context, relevancy deals only with the perception of the general importance of these topics – not to the specific arguments constructed or evaluated by these participants – but to their own lives. To further complicate things, one participant, Amy, perceived it to also mean the relevancy within the general realm of scientific investigations which I needed to include in this section. It also needs to be mentioned that relevancy is a tenuous topic when considering personal lives, because these lives include their experiences and views on race (i.e., Bailey and environmental school and organic vegetables) which is discussed separately in another section. Because of the significance of race as an important social construct in identity, it will remain separate in this paper. Presentation of these results are necessary to include within the context of science identity because students reconcile these topics within their own complex lives which helps constitute a part of their own science identity (Calabrese Barton, 1998; Carlone & Johnson, 2007; Sadler & Zeidler, 2005). In other words, how relatable these topics are into their own lives could affect how they respond in the science classroom (Carlone & Johnson, 2007).

4.5.2.1.2.1 Amy and scientific investigations

In the general realm of scientific investigations, Amy states this in her interview,

[Irrelevant topics are] just a way to learn something new. Because it's not relevant, people aren't talking about it. There are no ways to solve it yet. You can probably be the person to come up with that solution or to express ideas along with that other person. Julie…she said that a way to reduce the amount of the, I’m going to say non-native species…was to put carnivores on there. So then, that could probably reduce the amount of non-native species that are there. It has its pros and cons. That was a way.
In the above passage, Amy relied on an example of a case study that Mr. J. assigned to the students following the end of my study to reinforce her beliefs regarding scientific investigations. This is still a good indicator of Amy’s general perspectives as it pertains to scientific discoveries (NGSS, 2013). This statement also could have easily fallen under the NOS understanding, “scientific knowledge is open to revision in light of new evidence” as discussed in the previous section (NGSS, 2013, p. 4). However, its significance within this section was predominant.

4.5.2.1.2.2 Relevancy to personal lives

Participants also discussed the relevancy of certain topics that were explored in the argumentation-based activities as it related to their own personal lives. Participants found connections to their family and career goals. April seemed to change her mind throughout the interview – believing that global warming was relevant to all lives (not just hers) but also believing that it would not affect her personally, at least not for a long while, as seen below.

**April:** It could eventually affect us because we’re part of the ecosystem and all ecosystems are related and connected, like a food chain. And so, whatever, if something goes wrong in part of the food chain, then the whole chain is messed up.

**Phyllis:** Does that worry you?

**April:** It doesn’t really, well, it does a little bit because its going to affect everybody.

**Phyllis:** Do you think that it’s going to affect you in your lifetime?

**April:** Probably not.

**Phyllis:** Do you think about it when it comes to having children or grandchildren…or even someone close to you…their kids. Does that make you think about it…or not just yet?

**April:** It probably could affect them later on since…a ways…since that’ll happen. If we continue to go the way that we are, it’ll probably be sooner than what we expect.

**Phyllis:** But not necessarily a serious concern right now?
April: Yeah.

In the classroom, however, April, used extending and restating strategies (viewed in lines 4, 11 to 12, and 19 in the subsequent passage) to show that the ecosystem does affect everyone, something she confirms in the interview (Bloome et al., 2005). During these activities, questions were posed in ways that prompted students to personalize environmental topics. In the passage below, April followed the cues of the question and personalized the response by including “we” in her message units and statements along with Katie and Vicki. Her talk of eating animals and becoming vegetarians implicated a connection to her own diet as well. Her statements are bolded to emphasize her use of personalization. I’ve also included the conversation strategies with the bolded statements (Green & Wallat, 1981).

1. Katie: (reads question number 4) How do the issues examined in this program relate to you, if at all? Katie reads again for clarity to Vicki: How do the issues…in the video? affect us? Do you think that the animals affects us?
2. April: Some, but…some of us eat animals. Yeah. (extending)
3. Katie: It’s like the question above. Without, the animals, then the environment would change, and then the ecosystems, and then the, economy (or ecology) would change, and then we would have to change, so…
4. April: And then we would be vegetarians if we didn’t have certain animals. Well, like, most of eat, like, meat. …like… (extending)
5. Katie: Right! Well then, you know, we’d probably be (unintelligible)…then
6. April: (laughs with April. And then without sharks, there would be too many fish, and they would change and they would eat each other. Maybe, it’d be…
7. Katie: It would be crazy. Like everyone would change. So, do you think it doesn’t do it to us, or it does?
8. April: In a rather confident answer. It does. It does. (restating)
In presenting this in front of the class, April again followed the prompt of the question by including herself in the long-term environmental influences as discussed with her small group. This is apparent in the bolded phrase in the subsequent quote.

Number 4 says, how does this program relate to us? Well, like with the China thing, their diet will change, because they have all these delicacies, and all of these animals that they are eating. And if they go extinct they will have to find something else to eat. And the economy would change because they are making profit off these animals…um, and **we will be affected too because we are part of the ecosystem.**

April was not the only participant that realized a personal connection to the environmental issues. In the classroom, Brandy, and Maya seemed to stare with interest at a video segment that discussed zoonotic viruses. Brandy confessed that she connected her own career goals with the content of the video.

Just to see how you can, um, just get it from animals. That was interesting. Just, not people…people contact. You can actually get them from animals. I definitely feel that after watching these videos, it makes me wanna go into the medical field more. I don't know, it just, certain stuff just catch my attention. Like, there’s ways that you can help people. You don't just have to sit back and watch people die. You can actually help people in different ways.

Maya connected both the zoonotic viruses and an additional segment on ivory tusks, where elephants were illegally killed simply for their ivory tusks.

**Maya:** Because it's like … For example the zoonotic virus, what if you come in contact with someone who has that and can infect us? The ivory tusks, my grandma had statues and stuff and I never knew that those statues were made out of the ivory tusks.

**Phyllis:** Oh, there was the ivory tusks too.

**Maya:** Yeah, that.

**Phyllis:** Is that what you were referring to?

**Maya:** Yeah. Made out of ivory and whatever. Yeah. It's more like the zoonotic, yeah, that could affect us.

**Phyllis:** With the ivory thing, when you found out your grandma had something that was made of it, what did that make you feel?

**Maya:** Because I didn't know until I saw that video, then I ended up remembering that my grandma had a whole bunch of statues and it was … I don't know, it kind
of, I guess to me seemed cool, the curves. That and making statues and stuff, but 
yeah. I don't know if that answered your question.

Phyllis: It's cool that it was carved into a statue…
Maya:…but it wasn't cool that they had to kill [the elephant] though.

Bailey felt as if the class, overall, was relevant to her future goals, though she had 
not decided what profession she was specifically interested in pursuing.

Bailey: Well, I don't know. It's like giving me ideas for what I want to go to 
school for. So, like –
Phyllis: Really?
Bailey: Yeah.
Phyllis: Like what?
Bailey: Uh, I'm not, like, that's what I'm not sure of. But I like science –

As mentioned in a previous section, Kylie discussed the lack of relevancy of 
environmental topics in the APES class.

Stuff like that’s happening in our state, with our lakes with our, in our, in our 
lives. We talk about stuff in different, in the…well, not so much in the book, but 
in different articles and stuff that has nothing to do with us. Like, talk about like 
whales. What does whales have to do with our lives? Like, there’s no whales. 
That’s stupid.

As previously mentioned, Kylie displayed an overall ambivalence to environmental 
science, though she did like other science courses.

4.5.3 Race in the classroom

In this study, race was an apparent social identity that needed to be addressed in 
three distinct ways. Discourse analysis of observations and coding of interviews revealed 
that the ways participants used race was categorically different. First, race arose in the 
construction and evaluation of an argument. However, it was not something that was 
always easily captured in classroom observations but manifested in the linguistic 
evidence of the participants, particularly in the words that were used in the message units 
along with information revealed in interviews. Second, race also arose when assessing
the overall classroom dynamics of the participants in explicit ways (i.e., the mentioning of race in classroom conversation) and lastly, implicitly (i.e., linguistic evidence that was noted through small group and classroom discussion). For the last approach, participants were coded based on their non-verbal behavior which highlighted the need to assess the message unit and video segment further. This code was typically, Black female student silent during argumentation activity (long) in the tables used for discourse analysis (please see Table 18).

4.5.3.1 Race: explicit in an argument

As mentioned in previous sections, Bailey was one participant that undoubtedly used her racial identity when constructing and evaluating arguments within her group, which typically consisted of Adam, Xavier, and often times, Jim. In several cases, a Vietnamese male student, Victor, sat with them but hardly spoke. Because of the comfort that Bailey felt with the other Black group members (something she mentioned in an interview), there were several instances in which race surfaced in these conversations. These passages were first presented in section 4.2 on lived experiences. In the first passage, Bailey begins this segment using her perspective as a daughter of a single mom (line 4). When race is specifically mentioned (line 32), she discusses this using a school identity (line 27), recalling her days as a student in an environmental science school.

Please see Figure 22 for an analysis map of a portion of this segment.

1. Xavier: We have to care more about this earth (crosstalk).
3. Xavier: I know.
4. Bailey: My mom be buying that stuff. That stuff tastes so much better.
5. Strawberries and stuff, they taste so much better.
6. Xavier: They do?
7. Bailey: Yeah, and it lasts longer. Without using pesticides and stuff?
8. Xavier: Why do they do it? They do it to make them last longer, you lying.
9. Bailey: Pesticides… (Gives Xavier a confused look)
10. Xavier: They put all the stuff in there to make them grow quicker and last longer.
11. Adam: I know.
12. Xavier: They do. Don’t they?
13. Bailey: We just said not when it’s…their organically grown.
14. Xavier: Not when you’re growing organically. I bet they put preservatives and stuff in there, to grow faster.
15. Adam: Not when it's organic.
17. Xavier: I doubt that. I thought when they put that stuff in there, they try to make it last longer.
18. Bailey: Yeah, but, If you go to Makers [pseudonym for grocery store] and you look at the strawberries that are regular and their size and stuff and you look at the organic strawberries and they’re completely different. I know, ‘cause my Mom, she’s weird…and she eats all that stuff.
19. Adam: They got to make it more affordable for the normal person.
20. Bailey: Yeah, I know…cuz I talked about…cuz I went to an environmental science school, um, middle school, and elementary and middle school environmental science.

Evaluating this even further shows that Bailey tied her racial identity in with her identity as a daughter and her socioeconomic status by emphasizing the strawberries as being “expensive” and specifically discussing the high expenses as off-putting to African-Americans (and Mexicans) – a group that she proudly identified with in interviews. Because of the inclusion of economy, which implies that she considered the cost of strawberries relative to her life, it is also applicable to say that Bailey is referring to her own social location – the place in which race and her socio-economic status is placed in the hierarchy or her society (Weber, 2001). The argument that Bailey also constructs is not a formal argument directed at the assigned question which asks if local or global environmental and economic priorities can be balanced. Instead, it is a response to the use of evidence (organic strawberries) that she initially suggests as an example of these priorities being balanced. Bailey was the only participant that explicitly used race in her
arguments. In other cases, as seen in subsequent sections, race was implicated while the participants took part in argumentation. This manifested later in the interviews.

<table>
<thead>
<tr>
<th>Message Unit</th>
<th>Social identity within the narrative</th>
<th>Social Identity Within the Story Telling Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xavier: Okay, kepp going</td>
<td>NA</td>
<td>Reporter</td>
</tr>
<tr>
<td>… We were talking about that kind of stuff</td>
<td>Bailey enacting younger experience in school science; enacting academic identity</td>
<td></td>
</tr>
<tr>
<td>She [the teacher] was basically saying how African-Americans, Mexicans can’t really afford…stuff like that.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>That’s why they buy, like the regular stuff. Don’t nobody wanna buy organic stuff because it costs too much.</td>
<td>Bailey enacting racial identity within academic experience/ emphasis on economy (i.e. finances)</td>
<td></td>
</tr>
</tbody>
</table>

*Figure 22 Identity map for Bailey*
4.5.3.2 Race: implicit in use of argument

4.5.3.2.1 April and the collective identity.

During the interview, I asked April about a certain classroom episode involving a discussion with her group members where they spoke of global warming. In this activity, April consistently connected this issue to its eventual consequences to human beings. She also asserted the need for citizens to take charge in finding solutions. In this interview, April explained the reasoning for her stance on global warming as seen below.

Well, the fact that it’s been an issue with global warming and, ummm..the fossil fuels is the cause of it…and so with the fossil fuel thing, I did sort of feel firmly about it, because it’s our fault the reason why there’s global changes in the world. So I think it’s our business to do something about it and reduce it.

Her explanations along with the use of “our” implied a need to view such issues from a collective identity standpoint (Melucci, 1995). According to the sociologist Melucci, a collective identity is a process involving the complex relationships of “actors” and the ways in which they make decisions to take part in an action (Melucci, 1995, p. 45). These actions, according to Melucci, are those that take place in contemporary social movements. From this perspective, April discussed these individuals – including herself – as “actors” that should strive to find solutions to global warming (an action) since they were responsible for global warming (Melucci, 1995, p. 45). This view seemed much more important to April than viewing how these environmental issues affected her as an individual African-American young female as seen in her interview when I asked her about this. She responded, “Because, well, here with the environmental things that we had. I just think that it doesn’t affect me, just me, I just think that it affects everybody because we are all a part of the same world. So…no difference.” In the classroom, April
also used words such as “we” and “us” frequently when discussing these issues that coincided with her assertions in the interview. It is important to mention that her group members, Katie and Vicki, also used these words. This was especially observed in questions that were structured to personalize what was being asked. However, I also noted that no other participants personalized their responses using these pronouns as frequently as April did. In addition, themes that were captured during April’s interview were framed in a collective category such as, *global warming caused by human beings, global warming-human beings should reduce it, and global warming – change in ecosystems affects humans.*

Although April did not associate global warming with her own specific lived experiences, she also spoke of her strong religious identity in the interview which has been connected to the concept of collective identity in literature (Coleman & Collins, 2012; Jakelic, 2012). This will be discussed more in a subsequent section.

4.5.3.2.2 Brandy: lived experiences, racial identity and evaluation of arguments.

As stated in various sections throughout this chapter, Brandy relied on her own lived experiences in the evaluation of her arguments. Please recall that Brandy lives in a predominantly Mexican neighborhood where she asserted that the Mexicans there “get along well with Black people because I guess they consider themselves African-American”. She remarked that the Mexicans that she is in contact with, “…don’t really like White people. I can say that.” In Brandy’s last statement, she attempted to reconcile Mexicans’ relationships with the Black people in her world by implying that Black people do not like White people as well. This description is necessary to understand her reasoning during the evaluation of the town hall simulation arguments. I also use *social*
location to describe Brandy’s identities because the social location may be considered as a conglomerate of identities (race, gender, socioeconomic status etc.) and how they are socially placed in the hierarchy of one’s society (Weber, 2001). Brandy’s complex racial identity is also strategically placed within her community which is considered lower in socioeconomic status compared to other communities in the surrounding area.

During classroom observations, Brandy vocalized the consequences of traffic to Javier, a fellow citizen of nature who is an African-American male. However, she was not explicit in her evaluation as it relates to her own social location or lived experiences as seen in this exchange.

Javier: …Also, if they make it into the park, it would be a lot more to do.
Brandy: That’s why I’m for it, but I’m against it. Because people who live there? It’s going to cause more commotion for them (claim). Like, it’s going to be a bunch of traffic, a bunch of people there, a whole bunch of loaded noise (personal evidence from lived experience). And they don’t want that (cognitive reasoning) I don’t know if you’ve read the community reaction?
Javier: I didn’t read it yet.
Brandy: So, I’m, like, in between.

Brandy hinted at understanding what it is like to have an additional building constructed in her community by saying, “And they don’t want that” as her reasoning. In the interview, Brandy discussed the construction of a dollar store in her own community, normally a strategy that could boister a neighborhood of working-class residents. However, Brandy showed slight disgust in the interview towards the students who represented the Chamber of Commerce during the town hall simulation and their repetitive comments concerning the addition of more money into the community.

[The Chamber of Commerce] were just like more focused on bringing in MONEY and they didn’t seem to care really about the people that were in the neighborhood. They didn’t care. They just wanted MONEY, MONEY…they were money hungry. But, um, they didn’t really touch base on how the people would be affected or anything like that.
Brandy went on to provide more insight on what she meant by caring for the people.

I just feel like they should have looked at more of the people’s shoes that live in that neighborhood. They’re so use to peace and quiet, and now you’re just bringing in all this chaos. Like, that’s just going to affect them greatly. I can kind of relate to that, because where I live, it’s kind of like peace and quiet. But now they just built this huge Happy Dollar over there. So now it’s, like, a lot of traffic and it’s just crazy. I don’t understand why they ever did that. ‘Cause it’s just too much traffic. And it’s like, a lot of kids in that area, ‘cause it’s an elementary school over there? And with all that traffic, like, kids are getting hit by cars and some kids…kids are more likely to get kidnapped now and they’re just trying to walk to the store.

Evaluating this passage from a perspective that explores identities results in insight, not only to the socio-economic and racial nature of her community, but also of an individual who cares about the neighbors, particularly vulnerable children. In this case, like Bailey, she reconciled her academic identity with several others, her race and socio-economic status as well as her role as a concerned neighbor/resident, friend, and aunt.

4.5.3.3 Race – classroom dynamics (explicit)

Amy – “If you haven’t noticed, I’m Black”

Amy, an APES participant, was the only participant that explicitly discussed race in the classroom outside of the use of constructing and evaluating arguments but relative to the argumentation-based activity itself. During this time, she had conversations with Jerome, the bright African-American male partner for her field trip, and Emily, a White female student who happened to be sitting with them during their field trip preparation.

This was interesting to see, especially since I noted that she did not seem to show discomfort via her contextualization cues. Amy was even the first to contribute race – based comments in conversations that did not necessarily require her to do so as seen in this passage.
1. Emily: I know, but I'm wondering how I should measure the depth. Should I just like bring a yard stick and just like, "Oh it's..." You know what I mean?
3. Emily: That's why I'm wondering how deep it is.
4. Jerome: You can use a plumb line, you can use…and mark it. You can use a tape measure, you can use a yard stick.
5. Amy: I don't think we're going that deep though.
6. Emily: That's why I'm wondering how deep it is.
7. Jerome: You can use a plumb line, you can use…
8. Emily: I might just use a tape measure and tie a weight on the bottom of it.
9. Jerome: That's not how tape measures work but OK. I can get you one that'll work like that.
10. Amy: You sound like a drug dealer, like, I can get you something.
11. Jerome: I mean if you need one.
12. Amy: If you haven't noticed, I'm Black.
14. Amy: And I don't do deep water. I can't swim.
15. Emily: I don't do deep water. It scares me.
16. Jerome: Oh, actually 70% of Black people can't swim.
17. Emily: I can't jump off the pier. It freaks me out.
18. Amy: I'm part of the 70%. I can't swim.
20. Amy: Nope. Only person in my family, my dad, can swim. He taught himself.
21. Terry: I can swim.
23. Emily: No I can't jump off the pier. It scares me. Deep water scares me.
24. When I was in Mexico...

Before clearly discussing her race, Amy made a reference common in a culture that includes recreational drugs and jokes with Jerome in regards to this. From here, it seems as if she uses a thematic shift in mentioning race (Bloome et al., 2005). Amy begins a message unit that highlights her racial identity in the first bolded statement. Before Amy’s remark, Jerome and Emily were simply discussing the right equipment to use for the river without knowing the river’s actual depth. After Jerome’s initial surprise with Amy’s thematic shift, captured by the word, “wow”, he follows along in this conversation by providing an inaccurate statistic regarding Black people and swimming. Amy used restating strategies to emphasize this stereotype in the last bolded statement until the end of the video segment. In her own way, by using a raising strategy, Emily seemed to imply
with her interjection that not being able to swim is not just limited to Black people but may also occur with White people as she cannot swim (Bloome et al., 2005; Green & Wallat, 1981)). In her second and third attempts, she used a extending strategy by starting to begin a story of her time on a pier to help illustrate this point (Green & Wallat, 1981). Terry, a young male who is at least part African-American, also volunteered that he can swim as well, which Jerome dismissed in a way that is considered a code of confirming- (Wallat & Green, 1981). In other words, Jerome acknowledged Terry’s remark but still did not take it seriously via the content of his message unit. Overall, both Terry and Emily were generally dismissed by both Jerome and Amy as they discussed Black people and swimming.

It was when I pointed out Amy’s openness with regards to discussing her race in class (along with Jerome) that she admitted to me that she considered herself a “representative” of the Black race. After looking at her quizzically, she responded,

**Amy:** I do, because I'm proud of who I am. I feel like as Black people, they don't have representatives like me. They don't.

**Phyllis:** To just speak up for them.

**Amy:** Yeah, they really don't, because –

**Phyllis:** What Black people do you think, in this school or just in general?

**Amy:** Probably just in general.

**Phyllis:** Really?

**Amy:** Just in general, yes. What I want to do – I’m roud of who I am and where I come from. And I like the fact – I don’t like the fact, but I appreciate the fact of the oppression that we've been through and how it can shape lives throughout generations because of that. That will always be there. It's the fact that, with education, I just have to work a little bit harder just to understand a little bit more things.

In other instances throughout the interview, Amy freely contributed information in regards to her personal life that demonstrated her representative role and pride in her Black identity: discussing the need for Black people to be more informed in regards to
resources during natural disasters in her community and the need for more activities and venues for Black people in the Riverwest community. However, this openness was in stark contrast to how she manifested this pride in the classroom – at least superficially, it seemed. In classroom discussions regarding case studies, she enacted her racial identity in a unique way. This will be explored at length in the next section regarding the implicit use of race and classroom dynamics.

4.5.3.4 Race-classroom dynamics (implicit)

4.5.3.4.1 Bailey and her discomfort.

In section 4.2., the group dynamics of Bailey and her “regular” group, Xavier, Adam, and Jim were explored via classroom observations. The section presented examples of a group who felt comfortable voicing their various perspectives with each other. Subsequent to this activity, I noticed that Bailey was not as outspoken when placed in a group different than her own. This occurred during the town hall simulation. Her contextualization cues – lack of smiling and quieter tones – indicated she was more serious and reserved. In an interview following this episode, Bailey confided to me that being moved to a group of White students made her feel uncomfortable and less likely to contribute to the discussion. Before attending the diverse Riverwest, she stated that she attended public and charter schools that were predominantly Black. This familiarity stuck with her even after she began attending Riverwest. I showed Bailey video clips of her in the original group (with Adam, Xavier, and Jim) and her new group (consisting of two White females and one White male as well as Adam). These were her responses after viewing her subdued nature in the latter group.
Bailey: A lot of schools are, like, a lot of students at the public schools are… African-Americans go to school there. Mainly African-Americans, so…but this area…there's not a lot of them, so…

Phyllis: Do you think that because you're able to sit with – most of the time – Adam, Xavier, and Jim, and all of them…Do you think that that it helps you as a student? Or, do you think if you had to move to a different –

Bailey: I wouldn't feel comfortable.

Phyllis: With other White people? Or is it just anybody outside of being African-American?

Bailey: I just think it's easier to get along with your own race.

Bailey’s silence dealt with discomfort with group’s race. However, I realized that silence did not always signify discomfort with people who were not African-Americans, although race was a factor. This was the case when evaluating Amy during her video segments.

4.5.3.4.2 Amy and the weight of historical oppression.

Revisiting Amy’s racial pride is necessary to demonstrate the unique ways she enacted it in the classroom. As presented earlier, videotaped classroom discussions showed that Amy scarcely contributed her own perspective– two times – for case studies outside of the presentations that I discussed in section 4.2. During these times, her silence was highlighted after coding her identity assignment as, Black female student silent during argumentation activity (long). Although this code was typical with the other participants, Amy stood out because of how she explained this silence in the interviews. Please recall that Amy used the word, “stupid” when describing her classroom experiences in a previous section where she discussed voicing her opinion. For example, she states,

I guess you could say [the class] is good, but it’s bad at the same time. When he gives you that look, it’s like, is that a stupid question? That look. Maybe my opinion was wrong or something. You never know what’s wrong or what’s right. I was just lost the first few days [of class].
This occurred again when I noted a solution that she proposed regarding the safety of gray wolves during the interview was not offered in the classroom discussion. In response to this, she states, “Yes, but then I thought that would be stupid so then I was like, let’s not say that.” She continued by saying,

No. It's just because it's Mr. J and everybody else in there. When I answer a question, I usually know what I'm talking about. With that, I didn't know. I just don't want to say anything that's stupid. Not stupid, but that's not related to the topic. Because everyone else that said what they would do in that situation were really good at solutions. Mine was why wouldn't you just go undercover to see what they're doing. Just you can stop it by that. See? (after looking at Phyllis’s face) Yeah.

It is clear that Amy seems to have issues with ensuring that she says the right thing in her class. I explored various reasons for this as found in an analytic memo that involved all of the participants and their silence in classroom discussions. One may perhaps sense the confusion and frustration I felt in this memo.

I’m noticing that overall, the participants are not talking as much as other students in the class. Well, it seems as if, overall, the same students talk in the class, and maybe I’m just frustrated that these girls are not just talking enough for ME. I need to realize that them talking is evidence for something too, but I’m worried that my presence is making it difficult for them to speak up. What do I do? Analytic memo - October 10, 2014

However, for Amy, she provided reasons for her silence during her interview:

Things are, even with history, things just have been…just have been given to [White people], you can say. It helps them a little bit. I just want to understand things more. I just try and push myself more, so I can understand that. That’s why I’m so hard on myself because I want – not saying I want to be on their level, but I just want to do good for myself. To actually understand things. That’s why, when I was like, I don’t want to ask a stupid question, not a stupid question, but have a stupid answer, I just want to have my answers prepared. I want to just be organized. I want to work hard for what I have.
Amy was not the only one that remarked on her appreciation for ancestor’s struggles. Maya also discussed the strength and perseverance of her ancestors in her interview as she states,

If we go all the way back from slavery and stuff when we didn’t even know how to read and write. Learning how to ... finally learning how to read and write and learning about science, it’s just really ... I don’t know. Everything’s like...people were, like, just strong people and knowing that...you know, on top of that...like, learning about science and then becoming doctors...it’s pretty cool.

For Amy, however, the silence that she offered in the classroom is a careful silence that she displays to ensure that she does not disappoint the ancestors of her past, charisterically different from the admitted general shyness that Maya displayed in the classroom. Amy’s acts alone highlight how significant this research into her Black history meant to her. However, her explanations for these silences really made me pause. After the interview, I wrote out my feelings with regards to Amy’s last comment above in another analytic memo, because it really struck me. I felt it necessary to be upfront with my feelings in regards to my own experiences as a young Black woman in high school.

I thought of my brothers teasing me for being “militant”, my Malcolm X shirts and rostas that I wore in my predominantly White high school along with a glare to anyone who made disparaging remarks on my attire. I thought of speaking up in American History class in defense of the looters during the LA riots that exploded after the Rodney King verdict. I would have hardly considered myself silent during those years. In fact, I was far from it. I can’t help but think of the ways I showed my own Black pride and how it differed drastically from how Amy internalized her knowledge of Black history.

This is not surprising considering science discourse studies show the multiplicity of identity process for students, particularly students of color (Brickhouse et al., 2000). However, this also highlights that – in the context of argumentation – such findings are still very much applicable.
4.5.3.4.3 April and the dichotomy between collective identity and avoidance.

In section 4.4, I presented psycho-socio and cultural factors that arose in the study. There, I presented a quote from April where she discusses her first day at Riverwest. Because of her high grades, she remarks that she was placed in an AP class that was predominantly White.

Aaaaannd...with my grades and stuff I was able to take AP classes. And I just felt as if, um, they thought I wasn’t smart enough to be in there, when I proved by my grades I was smart enough to be in there. But that doesn’t matter. I dropped all of them, and just stick to regular classes instead. The people in there are, you know, regular people (laughing). In AP, you try and strive to be the best. Better than everybody else and it’s just… Ima [sic] just be a best instead of the best. You know what I’m saying?

As I asserted in that section, April seemed to show a compliance to the structural barrier of Riverwest in that the reaction of the White people in her AP classes resulted in her moving to regular classes. There, she felt that she could comfortably strive to achieve her own academic goals – without feeling as if the White people in her old AP classes would judge her. This was in stark contrast to how she chose to construct her scientific arguments. As stated previously, April utilized a more collective identity when discussing contentious environmental topics such as global warming and its effects on the ecosystem. Although Amber adopted this stance as well when considering classroom dynamics, April’s experience deserves to be mentioned. The seemingly forced dichotomy between April’s choice to adopt a collective stance in environmental topics versus choosing to avoid classes because she did not feel a sense of community highlights a broad but pervasive issue, where students often feel as if the classroom environment is not welcoming to the historically marginalized. This has been discussed in literature
(Atwater, 1996, Brown, 2004, Zambrana & Macdonald, 2009) and will be explored further in chapter 5.

4.5.4 Other themes

4.5.4.1 Religion/Spirituality in the classroom and as a way of life

An interesting component was the inclusion of religion/spirituality for my participants. I first noticed this during the APES field trip when Amber walked up to me at the field site and confessed, “…we prayed on the way down here….” Amber was vocal about her faith during the field trip but Kylie remained silent. As her partner (and fellow passenger in the car ride), I created questions in the interview that would provide additional information on Kylie’s feelings regarding the field trip. During this interview, the typically quiet Kylie informed me that on the field trip she did use her faith to combat her fears on this trip, such as riding in a canoe, drowning, etc. Amber proudly told me in an interview that her Grandma, when finding out about the field trip and her fears, started praying and reading scriptures for her. She stated,

I don't go to church every Sunday, but I know my parents. My Mom and my Grandma are really church-oriented. My Grandma, especially, because she goes to church every time the door opens. That's where I ... I don't know scriptures. I don't know ... I do know who I talk to. I don't go to church every Sunday. I know who my Pastor is. My Pastor knows who I am. I'm still in touch with it, but I don't read my Bible. I don't have a Bible.

In the RES class, April was not as vocal as Amber on the importance of religion, but the linguistic evidence in class – including the content of the message unit – where she used inclusive pronouns such as “we” and “us” in her scientific arguments – suggested that she adopted a collective identity. This was especially taken into consideration after her interview. Although we talked about religion extensively
subsequent to the formal interview, I will not include that portion because it was technically after the conclusion of the interview. Hence, I did not receive formal permission to use it, nor did I feel comfortable incorporating it into my dissertation.

However, this is an excerpt from the actual interview itself.

Phyllis: Do you think there’s a difference between religion and spirituality?
April: When I think about religion, it’s like you’re part of an organized group who has a set of beliefs.
Phyllis: OK.
April: And when I think of spiritual, I feel, like, like that… *(mimics a monk practicing mediation)*.
*Phyllis and April start laughing at April’s impression.*
Phyllis: Like, “Ummmmmm…..” *(attempting meditation practice as well).*
April: Yeah, like you’re connecting with something.
Phyllis: OK…so how would you, like, I mean, how would you describe your beliefs? Do you feel comfortable explaining them to me?
April: Yeah.
Phyllis: I consider myself a fairly open-minded person, so I don’t know.
April: I don’t consider myself…like spiritual…like my perspective of spiritual. Like, I do consider myself very religious.
Phyllis: Pretty religious is what you said?
April: Yeah.
Phyllis: So, um, going through the various activities of the religion, like going to church, is that what you mean or…?
April: I mean, like…
Phyllis: I’m just trying to understand your definition.
April: Well, I think that if you’re part of a religion, whatever they expect of you or not really expect…it’s from the Bible.
Phyllis: Mmmmmhmmm…
April: You follow it. And I don’t really think religion is really a religion. I just think it’s like a way of life.

April’s belief that religion is a “way of life” along with other conversations where she related her religious beliefs to Halloween: the students’ dress during that time, Mr. J. showing a movie related to Halloween and April reacting by sleeping to avoid watching it – indicate that April incorporated her faith in the school environment. Her religious identity, often manifesting into her collective perspectives during argumentation – based activities were an interesting part of this study.
4.5.4.2 Diversity makes it all better…for most

In a significantly diverse school such as Riverwest, it was difficult to see issues of race, disparities, etc. in the classroom unless it was uncovered in the interviews. In viewing the classroom make-up of the students, one could argue that the seating arrangement showed some segregation. However, a deeper look revealed that students were also separated based on sports, relationships, etc. as well. Bailey definitely made it clear to me in the interview that she felt more comfortable with the Black students in her group and experienced discomfort when situated with a group that included White students. She was, however, the exception for the group of participants in my study. Generally, everyone felt an overall appreciation for the diversity of the students found in Riverwest and how this aided them with classroom activities such as scientific argumentation. Common themes found in the interviews focused on the participants’ beliefs regarding the positive consequences of attending a school with a diverse student population. Amber focuses on the academic highlights by stating,

I feel like school now is not directed towards a certain race or certain gender. It's work, so you can graduate. It's busy work to do, so you can get out of school. It's nothing directly related to ... there's no groups for African-Americans. I'm not ... I know I'm African-American, but I'm not one that's, like, 'I'm going to join this group, because I'm Black’. I like people. I like everybody. If I like you, then I like you, not because you're African-American. Because if I'm in the group, I'm probably not going to like half of you all in the group anyway. Because you all don't fit my personality. I'm not going to join together just because we're Black. We know we Black. We don't got to be friends because we're Black. You understand what I'm saying?

As one can see, Amber adopted a collective identity along with April although she is more open when it comes to race compared to April. Brandy felt that the benefits of diversity are extended to how one behaves in the classroom. Initially, she focused on
discussing the general climate of the school but narrows this focus to discuss the academic consequences in a diverse school like Riverwest.

Brandy: Yeah, we all get along here. It’s not just the Blacks, the Asians, and, like...no. Everybody’s diverse. Like, um, we all get along well. There’s not really much fights here. Or drama or anything. It’s very...I’ve been here for 4 years and I can say I’ve seen maybe two fights.

Phyllis: I have noticed that...

Brandy: Everybody gets along here. It’s really nice. And the kids there, they don’t, like, dumb you down. Like if, if you’re failing a class or something, there’s a group of seniors that actually teach other kids...the lower classmen. It’s really, really nice here.

Further, Darlene succinctly stated this in regards to her academic skills, “I mean, because everybody is different and I know that everybody learns different so my skin doesn't really affect my brain, I guess.”

Brandy and Janice asserted that diversity in Riverwest aids in a lack of judgment on appearances. Brandy stated, “Because I feel that they don’t judge you on your skin color like they’d do in different schools. They don’t. they just look at you like you’re just another person in here. They don’t really judge you at all.” Janice agreed and mentioned that she “doesn’t want to be around the same people”. In addition, she stated,

Being in this school system for a long time...because, it’s been a lot...there’s a lot of different races and stuff like that. So, I don’t think that it’s something that people really think about. Well, I don’t. I don’t think it’s like a big deal.

Lastly, Maya revealed, “You get a glimpse and feeling of everybody. You're not just used to the same thing. It's different. Yeah, and you get to meet new people and stuff.”

The preceding quotes present an interesting look into how the participants, several who were initially in predominantly Black schools before attending Riverwest, appreciate the diversity of their current and how it relates to their education.
4.5.4.3 Authority in classroom/ othermothering

Collins discusses the concept of othermothering in her Black feminist theoretical framework (2000). In othermothering, Collins states how women who are not genetically linked to other individuals still portray characteristics of a nurturing caretaker. Classroom observations showed three participants acting in authoritative ways and were coded as, *participant in position of authority to others* and to a lesser extent *helpful to student (teacher, mother, friend).* Please see Table 18 for these themes. In the beginning of the study, Kylie and Darnell provided an exchange shown with the analysis depicted in Table 19 to present Kylie’s authoritative identity. During this brief time, Kylie asked Darnell if he completed a set of work. Her contextualization cues (i.e., stern unwavering look) suggests that Kylie held herself in a position higher than Darnell. Darnell, in turn, responded by lowering his head and looking at Kylie with what can only be described as slight fear. Although seemingly strange, assessing this video segment several times and paying close attention to his contextualization cues prompted me to code his identity as someone who acted as a son. Following a stern lecture from Mr. J to prepare for the field trip presentations, Amber harshly whispered to Troy concerning his absent twin brother who is also in his class, “Your brother better make sure he gets the hell in here!” Troy looked fearfully at Amber but nodded his head. And finally, Brandy prodded a late Maya to read the background of the community presented during the town hall simulation in the following passage. A portion of the discourse analysis for this passage is displayed in Table 20.

1. **Brandy:** Okay, Maya. You’re going to read that, and then you’re gonna
2. **Maya:** All of it? (incredulously)
3. **Brandy:** Well, just start right here. Just start right here.
4. **Maya:** All of it?
5. Brandy: Yes, Maya! Because you have to write an opening statement about it, how you feel about it. That’s what you have to do.
6. Maya: Can you just tell me what it’s about?
7. Brandy (talks quickly): Okay, they’re opening a park. And, they gonna cut down a whole bunch of trees, and get 300 men a job for that. Probably gonna get some money for that. Probably disturbing the peace, and you ain’t one for disturbing the peace so… Yep, but we have certain ones we have to write down.
8. Maya: (After reading for awhile) Okay, I’m against it (claim).
10. Maya: Yes, turn it down and say yes. Resident environmental issue. I’m against it.
11. Brandy: You’re against it. You didn’t even read it. (stern voice)
12. Maya: Said that they’re cutting down all the trees and making money and stuff.
13. Brandy: But they’re cutting down the trees and 300 men are getting jobs.
14. Maya: You don’t like that (rebuttal)?
15. Brandy: Maya, I think you should read it. You can read it right quick.

Brandy began this passage by giving Maya instructions calmly after Maya walked in late to class. At this time, it seems appropriate to code her identity as being a helpful student. However, beginning in line 6, Brandy’s frustration is apparent via her contextualization cues (i.e., stressing Maya’s name, Brandy’s raised pitch, and her looking incredulously at Maya). It is during this time that she starts to acquire more of an authoritative position. In line 18, Brandy even accuses Maya of not reading it – which may have been true given the short time Maya perused the paper – and is apparent by her stern voice and her stress on the word “read”. In line 24, Brandy again used a restating strategy (not found in this version of the template but in analyses) to advise her to read it.

4.5.5 Section Summary

Data sources revealed various identity processes and diverse ways in which these processes were enacted. Components of their classroom science identity included aspects of NOS (2013, NGSS). An important theme related to the participants’ classroom science
identities were the relevancy of environmental science topics to their lives and – to a lesser extent – within the general realm of scientific investigations. Race manifested in the construction and evaluation of arguments, both in explicit and implicit manners. The enactment of these identities also occurred when evaluating the classroom dynamics/social context. This was found to be in explicit and implicit ways as well. Other themes included those that focused on the diversity of the school, religion, and othermothering (Collins, 2000). The participants in this study showed distinct ways of reconciling their classroom science identities with their other identity processes. They also reconciled with topics relevant to their lives and – to a lesser extent – within the general realm of scientific investigations. Race manifested in several ways for these participants in the construction and evaluation of arguments, both in explicit and implicit manners. The enactment of these identities also occurred when evaluating the classroom dynamics/social context. This was found to be in explicit and implicit ways as well. Other themes included those that focused on the diversity of the school, religion, and othermothering (Collins, 2000).
Discourse analysis of Kylie and Darnell – “othermothering”

<table>
<thead>
<tr>
<th>Line No.</th>
<th>Speaker</th>
<th>Message Units</th>
<th>Contextualization cues</th>
<th>Interaction Units (lines)</th>
<th>Nonverbal behavior</th>
<th>Identities Signaled in Message Units</th>
<th>Linguistic Evidence for Descriptions of Identity</th>
<th>Uptake across Interaction Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Kylie</td>
<td>Did you do that homework†</td>
<td>Raised intonation at end of message unit and pause; waiting for response; Kylie looks to Darnell with “stern” look on face</td>
<td><strong>Beginning here</strong></td>
<td>Kylie is looking at Darnell with a stern look on her face.</td>
<td>Participant in position of authority to Darnell</td>
<td>Contextualization cues and content of message unit</td>
<td>Kylie is positioning Darnell as locator of knowledge in next message unit</td>
</tr>
<tr>
<td>2</td>
<td>Darnell</td>
<td>Yeah</td>
<td>Pause before ‘Yeah’ as he looks at Kylie. Raised intonation on ‘yeah’ atypical from normal tone. Darnell’s head is slightly lowered with eyes raised to meet Kylie. Hands under table.</td>
<td>1-2</td>
<td>Darnell looking at Kylie as depicted in c.c.</td>
<td>Participating Black male as “son” to Black female</td>
<td>Contextualization cues and content of message unit indicate submissiveness</td>
<td>Darnell is locator of knowledge by providing information to Kylie about homework status</td>
</tr>
<tr>
<td>3</td>
<td>Kylie</td>
<td>Good</td>
<td>Nods head simultaneously with saying ‘good’ while looking at Darnell. Mouth is in closed sternly.</td>
<td>1-3</td>
<td>Looking at Darnell with sternly closed mouth.</td>
<td>Participating in position of authority to Darnell</td>
<td>Contextualization cues and content of message unit indicate authoritative/mother/teacher position</td>
<td>Locator of knowledge switches to Kylie with her response.</td>
</tr>
</tbody>
</table>
Table 20
Discourse analysis of Brandy and Maya – “othermothering”

<table>
<thead>
<tr>
<th>Line No.</th>
<th>Speaker</th>
<th>Message Units</th>
<th>Contextualization cues</th>
<th>Interaction Units</th>
<th>Nonverbal behavior</th>
<th>Identities Signaled in Message Units</th>
<th>Linguistic Evidence for Descriptions of Identity</th>
<th>Uptake across Interaction Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>Brandy</td>
<td>OK Maya</td>
<td>Pause after “maya”; turns body to face Maya</td>
<td>Beginning here</td>
<td>Turning to face Maya</td>
<td>Helpful to student (beginning)</td>
<td>Contextualization cues</td>
<td>Brandy is the locator of knowledge</td>
</tr>
<tr>
<td>31</td>
<td>Brandy</td>
<td>You’re going to read that and then you’re gonna</td>
<td>Talking fast while pointing to paper which has background information. Alternates between looking at paper and looking at Maya</td>
<td></td>
<td>Pointing to paper and looking at Maya and Paper</td>
<td>Helpful to student</td>
<td>Contextualization cues</td>
<td>Brandy is the locator of knowledge</td>
</tr>
<tr>
<td>32</td>
<td>Maya</td>
<td>All of it↑</td>
<td>Looks at Brandy and the paper. Raised intonation at end of question and pause indicating end of message unit</td>
<td></td>
<td>Looks at Brandy and paper</td>
<td>Participant clarifying to Black female</td>
<td>Contextualization cues and content of message unit</td>
<td>Maya is entrusting Brandy as the locator of knowledge</td>
</tr>
<tr>
<td>33</td>
<td>Brandy</td>
<td>W+ell</td>
<td>Looking at paper. Long drawl on ‘Well’.</td>
<td></td>
<td>Looking at paper</td>
<td>Helpful to student/Participant acting in position of authority (teacher etc.)</td>
<td>Contextualization cues and content of message unit</td>
<td>Brandy is the locator of knowledge</td>
</tr>
<tr>
<td>34</td>
<td>Brandy</td>
<td>Just start right here. Just start right here</td>
<td>Stress on both “here”s while pointing to paper during message unit.</td>
<td></td>
<td>Pointing to paper</td>
<td>Helpful to student/Participant acting in position of authority (teacher etc.)</td>
<td>Contextualization cues and content of message unit</td>
<td>Brandy is the locator of knowledge</td>
</tr>
<tr>
<td>Line No.</td>
<td>Speaker</td>
<td>Message Units</td>
<td>Contextualization cues</td>
<td>Interaction Units</td>
<td>Nonverbal behavior</td>
<td>Identities Signaled in Message Units</td>
<td>Linguistic Evidence for Descriptions of Identity</td>
<td>Uptake across Interaction Units</td>
</tr>
<tr>
<td>---------</td>
<td>----------</td>
<td>-------------------</td>
<td>---------------------------------------------------------------------------------------</td>
<td>-------------------</td>
<td>-------------------------</td>
<td>---------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td>35</td>
<td>Maya</td>
<td>All of it↑</td>
<td>Raised intonation at end but higher pitch in tone; looking at paper</td>
<td></td>
<td>Looking at paper</td>
<td>Participant clarifying to Black female</td>
<td>Contextualization cues and content of message unit</td>
<td>Maya is entrusting Brandy as the locator of knowledge</td>
</tr>
<tr>
<td>36</td>
<td>Brandy</td>
<td>Yes, Ma+ya</td>
<td>Heavy stress on ‘Maya’ and drawn out. Raised pitch; looking at Maya (annoyed expression)</td>
<td></td>
<td>Looking at Maya</td>
<td>Participant acting in position of authority (teacher, etc.)</td>
<td>Contextualization cues and content of message unit</td>
<td>Brandy is the locator of knowledge</td>
</tr>
<tr>
<td>37</td>
<td>Brandy</td>
<td>Because you have to write an opening statement about it. How you feel about it.</td>
<td>Talking fast; looking at Maya; body turned to face her</td>
<td></td>
<td>Looking at Maya; body turned to face her</td>
<td>Participant acting in position of authority (teacher, etc.)</td>
<td>Contextualization cues and content of message unit</td>
<td>Brandy is the locator of knowledge</td>
</tr>
<tr>
<td>38</td>
<td>Brandy</td>
<td>That’s what you have to do.</td>
<td></td>
<td></td>
<td>Looking at Maya; body turned to face her</td>
<td>Participant acting in position of authority (teacher, etc.)</td>
<td>Contextualization cues and content of message unit</td>
<td>Brandy is the locator of knowledge</td>
</tr>
</tbody>
</table>
4.6 Implementation of Scientific Argumentation

4.6.1 Phase and thematic shifts

Overall, the use of scientific argumentation was limited compared to my original expectations when I first began this study. As a reminder, because this was an exploratory study, Mr. J. was not prompted to undergo an intervention such as the incorporation of the McNeill & Krajcik model (2012). Commensurably, he did not have a clear model from which to teach argumentation with the exception of the hanout used for the field trip.

One prominent finding related to the lack of argumentation was the issue of unexpected phase and thematic shifts throughout lessons that Mr. J. engaged in with his classroom discourse (Bloome et al., 2005). This occurred in varying degrees for all but one instance of whole-class discussion. As stated in the previous chapter, phase units are comprised of message and interaction units (Bloome et al., 2005). Examples of different phase units are an instructor’s lecture, a small group discussion, or a student presentation. Like message and interaction units, phase units are determined by contextualization cues. For instance, the original intentions of Mr. J. were made clear through contextualization cues in all episodes of these abrupt phase unit changes. Often, Mr. J. used open-ended phrases and words such as “opinion” frequently during argumentation-based discussions to encourage discussion. He also used non-verbal contextualization cues such as establishing a slight wait time after asking questions and looking around the room at his students between turns at talk. By attempting to respond to Mr. J.’s cues using their own contextualization cues, students demonstrated that they were up to participating in these
particular phase units. However, as this phase of the lesson progressed, the contextualization cues often shifted for Mr. J., and hence, the students. In these cases, Mr. J. did continue to use terminology that emphasized the expectation of contributing to an argument. However, other verbal cues (i.e., extended talk on the topic) changed this phase to a more didactic-centered approach. During these times, a select group of students continued to remain engaged. Still, others (including the study participants) responded in kind with their own cues such as looking down at the table, checking their cell phones, or communicating silently with each other, or working on other class work.

This passage involves a discussion regarding marijuana and the use of rodenticides on marijuana crops.

1. **Mr. J:** However, some of these in the Northwest, I think Oregon and a few other states, actually, it’s legal for in-home use but not for sale. That kind of thing. I think Oregon has that law. I don’t know about Washington and Alaska but I know Oregon has it where you can, if you’re at your house, like drinking, as long as you’re not walking down the streets, not selling it to other people. People can grow it at their home and enjoy it at their home. So I don’t know how that applies to these farms. But it’s definitely something where if there is armed guards, then it’s my assumption that these folks have…they’re not open to visitors or researchers. I think both of you are saying the same thing. If it was illegal, we would call the authorities. But what if it’s not illegal?

2. **Kylie:** But isn’t the authorities also a part of it all. Isn’t that why…?

3. **(Amber and Darnell are laughing, because Darnell has Phyllis’s recorder).**

4. **Mr. J.:** It could be, but this is new. Like Oregon just passed this law. That says it’s okay. Well, there’s also medicinal uses. And, I think that Oregon also has a farm legally. Several…many states in the US are allowing it to be, you know, you can have it for medicinal purposes.

5. For medicinal uses and people get prescriptions from doctors. Let’s play devil’s advocate. Let’s say, we’ll take away the armed guards out of the issues. And let’s say they’re legal farms. But, they’re putting out rodenticides that are affecting other animals.

6. **Mark (white male student):** Can you, uh, attract other fishers? Do you have enough evidence to prove that there’s enough causation and not correlation? Then you can bring some of that to…uh, like science communities that are well known, and from there, act.
26. **Mr. J.**: Okay, Okay. Some of these articles like this, We’re just going to do 27. We’re just going to discuss.

In this example, Mr. J is the initial *locator of knowledge* as a teacher providing information on some aspects of legal marijuana use (Bloome et al., 2005). As part of the discussion, he changed strategies to provoke responses from the students. In this event, Mr. J’s strategy in line 10 changes to one that is “raising the level of discussion” in his use of questioning (Green & Wallat, 1981, p. 198), cueing to his class that he expected an answer. Kylie then accepted his cue and proceeded to respond in line 12. However, incongruence resulted in the discussion when Mr. J. interrupted Kylie in line 14 while she attempted to contribute to the discussion to give an explanation. In the second shift of phase units beginning in line 14, Mr. J first switched strategies to cue a response from his class that he is intending a discussion. In this case, he began providing information on the legalization of marijuana in certain states, using an extending strategy which involves adding more information on the topic (Green & Wallat, 1981). He then cued to his class that he expected a response by his use of an additional raising strategy, albeit a statement and not a question in line 18. After Mark responded to this cue, Mr. J. switched again to a strategy described as “focusing” in line 26 by his use of the word “OK, OK”, which can be interpreted as “something [else] is coming” (Green & Wallat, 1981, p. 197). In this case, it is the announcement that the class will continue to discuss articles in his class. As described in previous sections, Bloome et al. described the abrupt change in content matter at line 26 as a thematic shift (2005). Thematic shifts are common in the classroom. One obvious reason for this is the need for the instructor to change from one subject matter to the next. However, Bloome et al. warn that such shifts must be approved by all participants in the classroom event (2005) Such approval may be in the form of students
moving on to the different phase unit as is suggested by Mr. J.’s focusing strategy.

However, this is problematized by norms in educational institutions – in which students are expected to follow the instructors of the classroom teacher. This will be further discussed in Chapter 5.

In another example below, Mr. J. was in the middle of a discussion with the APES students involving a case study concerning the hunting of wolves to protect residents in surrounding areas.

1. **Mr. J reads from case study:** “Number agreeing with negative statements such as ‘I would be afraid if wolves live near my home’ increased by 9 to 31%.” Would you guys be more fearful if you knew the wolf numbers were up? **Scattered student responses.** **Heard some yeah. Cannot see within scope of camera.** Kylie says yeah. She scrunches her face up. Kylie looks at Darnell with a startled expression. She also looks at him with disbelief. Amber strokes the strands of her hair and says something inaudible.

2. **Darnell:** I’m like a wolf whisperer.

3. **Mr. J:** Hands high gets the floor. James.

4. **Kylie shakes her head and scrunches her face up, closes her eyes in Darnell’s direction.** **Amber and Kylie whisper to each other. Kylie mouths to Amber.**

5. **Jerome:** I mean, wolves obviously are predators so they can eat and eat. And obviously there are going to be more of them. I’m not saying kill them all off, but we could figure out a way to keep them at bay…just, so I don’t have to worry about them.

6. **Mr. J:** I’m going to come back to you with a question. Craig.

7. **Craig:** I don’t think they’ll really bother us cause, uh…

8. **Mr. J:** Big voice. Big voice because they can’t hear you over here.

9. **Craig:** I don’t think they’ll bother us because they’ll be like coyotes and get scared away.

10. **Amber starts rubbing her right eye and grins at Kylie. Kylie puts her hand over her mouth. Looks to be a smile underneath her hand.**

11. **Mr. J:** True. I mean…the honest truth is, most wolves don’t want to be around people so they hear you come in, they’re gonna scatter. I will tell you guys the story that happened to a buddy of mine back when I was in college who is actually from Alaska and…what’s funny, because we all called him, ‘Yukon Joe’. Go figure, right, Yukon, Alaska, so…and he liked it. But he was actually telling us stories. You know, a lot of people think that wolves will hunt people. The Alaskan wolves will hunt people, we said, right? He said, no. Don’t believe the hype about these ones, maybe the ones in the Rockies, or in other parts of the US. But he said (**Mr. J closes Darnell’s laptop as he talks.** **Amber looks at Mr. J doing this, Kylie looks up at Mr. J**)
with interest). Alaskan wolves when they’re hungry enough and in the winter when there’s no kills being made and you’re out there by yourself, they will come up, and they will try and attack you. And (inaudible) trust me, because he did a lot of hiking. And he had been out there on days where the snow has been real heavy. And he said, ‘Dude, if I didn’t have that 38. rifle with me, I might not have gotten back’. He said, ‘Granted all I had to do was shoot it up in the air to scare them off’. He said, ‘But if I didn’t have that, they would’ve been hunting me’. Now, if you asked me my opinion…I don’t doubt anything that he says. But, I think any predator that is out there that’s big enough and they see you and you don’t give off signs that say this thing can’t defend itself or you got something scared enough to make them think that you’re not frightened…

Amber: (interrupts) I’ll growl back. I’ll just growl back, Mr. J. I’ll growl back. All right. Sometimes…sometimes…

Amber: Or run towards it. Amber is laughing with Kylie and Kylie smiles back.

Mr. J: All you have to do is give them a signal that says that you’re not prey.

Amber looks at Mr. J.

Amber: Say “I’m not scared of you! I’m going to run towards you if you run towards me!” (Amber is animated looking at Kylie and Kylie and Darnell look on. Amber waves her hands in a grandiose fashion above her head while smiling, pretending that she is a larger prey).

Mr. J: Hold up.

Jessica: Don’t they usually only attack when they’re scared?

Mr. J: Yep. A lot of, a lot of those types of, a lot of those attacks…their attacks have been when we scared them. They get caught off guard. You walk up on them. Yeah. Animals mostly live in this world. Here is the world they live in: life, fight, food, reproduction. That’s it. There is some that get up every day and say quote, ‘Hey, I wonder who’s hanging out by the pond. I’ll go see.’ Their day is getting up, finding something to eat, not getting surprised or scared by anybody. Maybe trying to find a mate if it’s that time of the year. The rest of the day is just trying to get up every day trying to get something to eat. So, we try and humanize animals and think that they go through the day thinking that they think like we do. But that’s not how they put their day together. When they wake up in the morning, it’s like, ‘Okay. It’s on Thursday. Find some water. if I’m hungry, then it’s time to go hunting. If, I’ve got cubs, kittens, whatever we call them…whatever we call their young…we’ve got to take care of these guys to make sure that they survive. If we spent our days like they did, then most of you all wouldn’t even be here. Because you all would be running around trying to scrounge up something to eat and then talk about coming to school. So you say, ‘Now I’m full. Now I can go to that place where they will teach me something. Because, right now I’m hungry, and that’s all that matters.’ But because we have a complex mind, we can conceptualize needing to learn.
In the preceding example which had Mr. J. standing near Amber and Kylie during the classroom discussion, Mr. J. used prolonged extending strategies beginning in lines 23 and 58. Although not as explicit as the example before, his use of an extending strategy that resembles a didactic-like approach continued.

RES students had limited whole-class discussion during the study period. However, in these cases, Mr. J showed evidence of phase and thematic shifts as well. For instance, in a wrap-up discussion for the town hall simulation, opportunities to expose more information on how students evaluated and constructed arguments did not take place. Instead, Mr. J. contributed his own personal experiences in regards to the simulation – the construction of a strip mall that resulted in the disruption of woods in the community. Although a very interesting way to connect the class work to real life, following up his story with additional open-ended questions to students that focused on their experiences would have provided another opportunity for students to explicitly make classroom connections to their own lives. This could have enlightened Mr. J. to various perspectives of his students that may have informed him in the subsequent times he used the town hall simulation activity.

4.6.2 Engagement of topic

In interviews with participants, questions were structured to ask about their participation and engagement in class in an attempt to uncover their thoughts regarding the extended strategies Mr. J. used in discussions. Interestingly, Kylie indicated the importance of contributing to class lay not in the state of the discussion as previously described, but in the topic of the discussion. Below is her response:
Kylie: Umm, I guess he talk about more stuff that's more relatable to us besides stuff that has nothing to do with our lives.

Phyllis: What’s an example of that, do you think?

Kylie: Stuff like that’s happening in our state, with our lakes with our, in our, in our lives. We talk about stuff in different, in the…well, not so much in the book, but in different articles and stuff that has nothing to do with us. Like, talk about like whales. What does whales have to do with our lives? Like, there’s no whales. That’s stupid.

Amber also discusses her beliefs on the topics presented to her in APES.

Amber: I wasn't ... I haven't been ... I do the case studies, because I have to. I don't do them because I find them interesting.

Phyllis: Why aren't they interesting?

Amber: I don't relate to that. I feel like we should talk about stuff, because some people do like this stuff. This does grab them – the case studies that he's been doing. But I think that we should find case studies of our own, or choose from a lot of topics. Because I know he has a lot of them. I think we should choose from topics that interest us, because then we'll be more focused on it. Rather than just doing it because it's work that we have to do.

Amy stated that her own individual challenges affect her engagement in class, not the extended strategies of Mr. J. These struggles were related to her racial identity and need for self-perfection. Concerning Mr. J., she explained, “I feel like it's a good class because Mr. J, he actually questions your opinion.” Amy’s unique view of her racial identity and associated individual challenges has already been explored in section 4.4.

4.6.3 Section Summary

Opportunities for RES and APES participants and other students to engage in argumentation were limited by the implementation of phase and thematic shifts by Mr. J. These phase shifts were characterized by raising strategies that indicated the prompting of discussion to extending strategies which transformed classroom discussions to a more didactic or lecture-based approach. Consequently, participants demonstrated contextualization cues that indicated a lack of engagement to the discussion, a finding that
was confirmed in interviews. However, during these interviews, participants focused on lack of engagement to the topic in class rather than the state of the discussion.

4.7 Summary

Overall, the use of scientific argumentation in both RES and APES classes was limited. Pedagogical strategies emphasized an intent to engage students in discussion when evaluating the instructor’s contextualization cues. However, phase and thematic shifts aided in changing the direction of the open-ended discussions led by Mr. J. into a more didactic approach.

Different argumentation-based activities for RES and APES classes were related to various approaches to scientific argumentation, with RES students formally constructing arguments based on various classroom activities (film, simulation, written work etc.). In these cases, participants made connections to evidence from films and activities in the form of scientific and topical evidence. However, there was limited use of reasoning in the construction of arguments. This lack of reasoning resulted in incomplete arguments involving perspectives related to important socio-scientific topics. When participants did use reasoning to connect claims with scientific evidence, it was generally cognitive. However, elements of caring arose in the use of reasoning (emotive) and stated claims. Advanced argumentation as described by McNeill and Pimentel (2010) occurred for participants in this study by use of rebuttal. APES students discussed case studies in class after answering various written questions based on comprehension and critical thinking skills. In these cases, the lack of explicit instruction was related to the completeness of the argument itself. However, evidence of explicit instruction in
argumentation and complete arguments manifested in one APES argumentation-based activity.

Participants unequivocally used their lived experiences when constructing and evaluating arguments and via discussions in interviews. These lived experiences were generally related to their social locations with themes of race, economy, and crime/safety predominating these events.

Exploring the participants’ lived experiences as they took part in argumentation-based activities uncovered psycho-socio-cultural and pedagogical factors. These potential gatekeepers were often related to their ability to take part in certain argumentation-based activities. These participants were active agents as it relates to these circumstances, however, reconciling and negotiating various strategies to ensure that they still were able to complete the argumentation-based activities.

Exploring the lived experiences of the participants also revealed their particular identity-forming processes. Participants constructed and reconciled their social identities along with their classroom science identity in various ways when engaging in argumentation, both in the construction of the argument itself and in the social context of the activity. This was manifested in general themes relating to race and feminism (othermothering), and religion. Besides this, themes relating to NOS and the personal and general relevancy of the environmental science topics arose as an important component of their classroom science identity.

The next chapter will provide a discussion and interpretation of the findings of this chapter within the theoretical framework of this study. It will also present the limitations of this study.
CHAPTER 5

CONCLUSIONS AND INTERPRETATIONS

In this chapter, I will discuss the conclusions and interpretations of the findings presented in Chapter 4. Overall, the purpose of this study was to explore classroom discussion using an argument model and feminist theoretical framework which highlighted the role of lived experiences. Included in this analysis was the need to also study the classroom dynamics while these girls practiced scientific argumentation. This chapter is broken down into seven sections for ease of discussion. Section 5.1 discusses the use of scientific argumentation as it relates to lived experiences. Section 5.2 discusses the inclusion of social identities into the argumentation model. Section 5.3 discusses lived experiences and the psycho-socio-cultural/pedagogical factors, and the need to evaluate a multiplicity of identities when evaluating NGSS. Section 5.4. discusses the important role of explicitly teaching argumentation in the science classroom. Section 5.5 discusses general implications for further studies that explores marginalized groups in scientific argumentation. Section 5.6 discusses the limitations in the study. Lastly, section 5.7 more pointedly provides the possible future directions for this project; although this is also discussed throughout the chapter.
5.1 Argumentation, Lived Experiences, and Implications

Please see Figure 23 which depicts the overall findings in my study. The figures following Figure 23 will help describe the various elements of this overall model.

Figure 23 General revised argumentation model

Evidence was presented in chapter 4 that demonstrated the use of lived experiences by participants in the construction and evaluation of their arguments. The description of lived experiences is used in myriad of disciplines to describe the unique lives of individuals from different social groups. However, Hill Collins (2000) describes lived experiences specifically as it relates to Black women. In her writings, Hill Collins claims that these lived experiences stem from structures of inequality (i.e., race, gender, and socioeconomic status) though other identities such as sexuality and religion exist as well (2000). Further, Weber uses the phrase, social location to collectively describe how
these structures are placed in one’s society. Because Hill Collins highlights the need for an in-depth analysis into structures of race, gender, and class, I use these categories to primarily describe one’s social location in the following discussion (2000, 2009). For four RES students, activities relating to the various roles of environmentalists and the human impact on nature led to the use of these lived experiences. Three of these participants related these experiences back to their own social location. For these three participants, the lived experiences focused on themes related to the environment but also anthropogenic-influences such as safety (i.e., crime and traffic), economics and education. As seen in Figure 24, a portion of the model separated out from the original schematic of Figure 23, these human-based factors were an integral part of the student’s physical communities (i.e., church, family, school, and the home neighborhood). Specifically, themes relating to safety and the economy were related to Brandy’s neighborhood. Bailey’s emphasis on the environment stemmed from her lived experiences as a student in an elementary environmental school as well as lessons learned as a daughter of an environmentally conscious single mother. Her emphasis on the economy also stemmed from her home knowledge (i.e., pricing of vegetables).

Bearing this in mind, one may further understand the origin of these lived experiences. For instance, Brandy discusses crime, safety, and money in the evaluation of her arguments as a citizen during the town hall simulation. These factors were all associated to her predominantly Mexican working-class neighborhood. Bailey’s themes of money related to her race and socio-economic status and are apparent from her remarks regarding the expense of organic fruits and vegetables for African-Americans.
In their construction and evaluation of arguments, Brandy and Bailey were not ineffective in the processes they used to create and comprehend these arguments. However, their strategies offer a unique way for them to reconcile the argumentation-based activities, making them relatable to their own lives.

Consequently, Figure 24 presents potential roles of the student and teacher in the process of argumentation when considering these lived experiences. The arrow directions of the students and teacher coincide with arrows facing similar directions between the concept boxes. In regards to the student, her social location plays a strong role in her lived experiences. These lived experiences may then influence how she constructs and evaluates a scientific argument as shown in this study. A practical implication for the teacher involves a deeper understanding into the nature of the argument itself as shown in the opposite directional arrows. In the classroom, teachers may look at how students construct and evaluate arguments to determine if they are relying on their own lived
experiences by listening to their rationale and use of evidence. This could be further ascertained by asking relevant questions to the student (i.e., asking Student A to explain her use of evidence). From here, the teacher may help reveal the student’s experiences. These lived experiences provide the teachers valuable information as to the possible social location and background of her student – a finding which occurred in this study.

Through consistent implementation of this strategy in her classroom, the teacher may then ultimately develop culturally relevant pedagogies that would address the various lived experiences of her students in ways that will aid in effective instruction of scientific argumentation.

5.2 Fitting Social Identities into Scientific Argumentation

Please see Figure 25 for the inclusion of “enactment of identities” to Figure 24. Understanding how the participants enacted their social identities requires a distinction between the social location and enactment of identities. As discussed in the previous section, the social location describes the position that society places race, class, gender in the hierarchy of one’s society. From this perspective, these constructs may be thought of as structures (Hill Collins, 2000). These structures are considered theoretical constructs that help define the intricate web of oppression. In other words, one may familiarize themselves with the historical and social implications that race, gender and, socioeconomic status pose for a particular society. However, this will be significantly
Figure 25 Model depicting role of identities
dergent than the “self-definitions” or ways that individuals enact these identities (Hill Collins, 2000, p. 1).

In Figure 25, the large arrows on the sides of the model indicate that the social location will help determine the lived experiences, which will in turn affect the self-definitions or the ways that the participants enact their identities. This model is a rudimentary construction of the realities of life, however. The complex nature of how identities are constructed and reconstructed as it relates to one’s social location may also reveal other findings. For example, one may find that how one expresses their social identities could provide clues into one’s lived experiences and social location, although caution must be taken not to generalize. For the sake of this study, however, the model shown in Figure 25 is an apt description to evaluate the possible role of one’s lived experiences in the construction and evaluation of arguments.
To add to the ambiguity of social identities, feminist scholars contend that these expressed social identities are indeed entangled in each other, with one or more presiding over others in various social contexts – a primary assertion of intersectionality theory. The girls in this study enacted their identities in various ways and demonstrated the complex intersection of how they interpreted their social location in light of engaging in scientific argumentation. One major identifying factor was the various ways they included their self-definitions of race with their classroom science identity in order to take part in scientific argumentation. Please see Figure 26 for an illustration of the participants’ science identities in relation to their social identities. In regards to this figure, it was very tempting to place science identity as the focal point. However, it is important to note that the social structures of race, class, and gender are constructs that permeate these participants’ lives irrelevant of their social context. Hence, these participants are constantly redefining or reenacting their identities based on their various contexts. Because of this, it was important to have an overarching object in Figure 26 that represented the complex social identities these participants may have expressed moment by moment in Mr. J.’s classroom.
Figure 26 Classroom science identity and other social identities

The classroom science identity in this study consisted of their beliefs (which were uncovered in the interview) and the participants’ classroom actions (found in classroom observations). The beliefs included the participants’ views concerning the relevancy or lack of relevancy environmental science had in their lives based on the argumentation-based topics they covered in Mr. J.’s classroom. For example, one APES participant, Kylie, asserted that the topics discussed thus far were not interesting and relatable to her life. Kylie expressed a certain resignation in regards to this finding, and resorted to completing her assignments to obtain a passing grade in Mr. J.’s class. However, Amy, another student in the APES class, seemed to discuss the lack of personal relevancy in a positive light by emphasizing the possibility of leading scientific discoveries. In doing so, she emphasized another important NOS understanding – science as a human endeavor (NGSS, 2013). The importance of these participants reflecting on their argumentation-based activities cannot be overlooked in light of NOS. The NGSS emphasizes that students must have the opportunity to reflect on their classroom practices in order to
“understand the importance of each practice and develop a nuanced appreciation of the nature of science” (2013, p. 7). Reflections expressed in the interview highlight the need for instructors to incorporate this into their scientific argumentation activities in the classroom. Such practices have already been addressed in literature.

Interestingly, the general portion of these beliefs also included an appreciation of science that incorporated NOS understandings found in the NGSS (2013). One APES participant, Amber, remarked on the dynamic nature of science that results due to the addition of new evidence. Her statement also highlights one other important role of scientific argumentation – constructing complete arguments from this evidence (NGSS, 2013).

Going back to Figure 26, the relationship depicted between the classroom actions of the participants and their beliefs is not one that indicates a direct correlation. Rather, it is indicative that a kind of relationship did exist between these two categories. For instance, Kylie’s beliefs regarding the irrelevancy of the topics to her own life were associated with her disgust of the field trip. Janice’s beliefs of the irrelevancy of the topics were related to her contextualization cues in the classroom as well (i.e., sleeping, checking cell phone, talking with friends in the group). Amber’s beliefs in regards to the adventurous nature of science were related to her brave actions during the field trip and her assertion for independence in riding in the canoe. Brandy and Maya’s general interest in the environmental topics presented in Planet in Peril were related to their contextualization cues in class (e.g., staring at the screen with interest, writing down responses to questions, etc.), demonstrating their entrancement with the material.
Science identity models in literature involve various concepts related to the research interests of the authors. However, an important element is how one perceives herself in the context of the science classroom. For example, in their study of women of color pursuing scientific careers, Carlone and Johnson found that the science identity of these women of color were related to how they perceived themselves, how competent they were in their science-related careers/career preparation, and how others recognized them as scientists (2007). As discussed in Chapter 2, Calabrese Barton created a science identity model for the homeless girls in her study with a major component of identity being how the girls perceived their own place in science (1998). In her model, Calabrese Barton acknowledges the role of power in the classroom via the teacher. However, she also emphasizes the inclusion of student agency that provides an accurate picture of how students may redefine the assumptions of the teacher (1998). In my model, the beliefs of the students included how relevant they felt science was in their lives. This indicates that these participants attempted to reconcile the role of science as it related to their other social identities.

Another extension to the lack of relevancy noted in this study is the use of reasoning in the arguments for these participants. Although the participants missed opportunities to provide rationale or reasoning with claims, when they did provide this reasoning, it was usually categorized as cognitive (Sadler & Zeidler, 2005). In Sadler and Zeidler’s study, which discusses the domains of reasoning found as undergraduate students reconciled socio-scientific issues and from which I included certain elements into my own model, the authors describe the three types of reasoning as rationalistic, emotive, and intuitive (2005). In emotive reasoning, participants used sympathy and
empathy in their rationale. Cognitive or rationalistic is associated with a logical type of reasoning. In their study, Sadler and Zeidler discuss emotive traits as being typically directed toward the “well-being of others” (Sadler & Zeidler, 2005, p. 73). The authors also note that use of this type of reasoning indicates a personal connection that students feel to the SSIs being discussed. It is then possible that the lack of emotive reasoning found in this study could indicate a lack of personal connection to the environmental topics discussed in Mr. J.’s class. Although the caring trait was not limited to reasoning in my own study, but also included in the claims, the few participants in the study did show sympathetic regard to the well-being of others (i.e., Brandy discussing the citizens of the nature preserve) and the upkeep of the environment including the animals (i.e., Bailey and April in regards to the Planet in Peril film). Although Sadler and Zeidler discuss the role of empathy and sympathy specific to the well-being of human others, the SSIs presented in their study included a significant human component, genetic cloning – something vastly different than the topics in Mr. J.’s class (2005). Implications for historically marginalized and socio-economically disadvantaged groups are significant. Sadler and Ziedler contend that students that use emotive type of reasoning still produce effective arguments (2005). Consequently, uncovering the lived experiences of students in the classroom may also result in the uncovering of these personal connections while constructing these arguments. As a pedagogical strategy, teachers may be able to implement this in classroom discussion or more formally into class work assigned to students (NGSS, 2013; NRC, 2011). This pedagogical strategy could then strengthen the students’ beliefs concerning science, including their place in science which would ultimately strengthen their science identity.
5.2.1 Reconciliation of science identity with social identities

5.2.1.1 Race and gender

As described in a previous section, I included intersectionality theory into my theoretical framework to acknowledge the need for researchers to assess the multiplicity of social identities that individuals constantly enact in various degrees depending on the type of context.

Although the term gender in present times constitutes more than just the biological sex of the individual, I will refer to gender as being a socially constructed identity that is determined in part by one’s biological sex (Lanehart, 2009). In this study, the ways participants generally enacted their gender identity involved exclusion of this topic from any discussions – in both classroom observations and interviews. One primary reason for the existence of intersectionality theory is to acknowledge that one’s gender results in different opportunities for individuals in society that range from economical to educational. Another assumption, according to intersectionality scholars, is that conflated theoretical frameworks typically view the marginalization of Black women as occurring either by race or gender, without attending to the complex interplay of both constructs. Gender also has other historical and societal implications. For example, the Black female stereotype has been separated into four distinct categories by scholars. These assumptions and stereotypes help exemplify the need for studies that include an intersectionality theoretical framework to uncover such biases in the context of the K-12 classroom. However, in my study, the participants did not discuss their gender in the classroom nor interviews. This was apparent even after I properly phrased questions to reflect an intersectionality component as described in literature. In these instances,
participants steered me to a discussion of race. Participants also used race similarly in the social context of the argumentation-based activity, enacting their racial identity in explicit or implicit ways, but not including gender in these ways. When gender was mentioned, it was from other students in the class who were Black male students. One young man teased Janice by telling her that as an African-American girl, she was not strong. This was not presented in the results because it was a few days after I began recording. It is possible that the male student was trying to acclimate himself to my study since I had recruited the class only a few days prior to that incident. In another instance, Xavier is heard comforting Bailey as she admits that she is overwhelmed with the work that Mr. J. had just assigned them, stating, “It’s too much” with her head down. In that moment, Xavier leaned across the table and reminded her, “You’re a strong Black woman.” In his sentiment, which undoubtedly came from a kind place, Bailey found some encouragement, as depicted in her contextualization cues of picking up her head and continuing to work. These were the only instances where gender was unequivocally expressed as found in my observations. One possible explanation for this involves an assumption of intersectionality theory. This assumption contends that one social identity may be expressed over others depending on the social context. For the sake of this study, the participants’ focus on race and not gender may be due to the relatively equal ratio of male and female students at Riverwest among all groups. Perhaps the participants did not feel the need to mention their gender as something that was particularly unique to them in the context of their high school when evaluating other racial groups that have seemingly the same gender distribution. From this perspective, race seemed much more prominent to them over gender. Also, it is likely that discussions that center on diversity are cues to
the participants that in their experiences, race is the more familiar and accurate measure of diversity. This is especially significant when understanding that four of the participants previously attended predominantly Black schools before Riverwest.

5.2.1.2 Different approaches to racial identity

5.2.1.2.1 Argumentation and social context.

The various ways race was enacted in the classroom highlights the agency of individuals in constructing and reconstructing their identities. Altogether, this brings to the forefront various self-definitions adopted by the participants when it came to how they identified with being African-American or Black in their arguments and in the social context of the classroom. Amy enacted her racial identity outside of the classroom by researching her Black history. This research into her history led to her silent behavior when it came to participating in classroom discussions. This silent behavior was her way of ensuring she did not say anything wrong that would disappoint her ancestors. Instead, Amy resorted to submitting written work that she deemed was good quality and agonizing over this work. Referring back to Figure 26, Amy’s enactment of her racial identity resulted in choices that affected her actions (a part of her science identity) during argumentation activities. During preparation for another argumentation-based activity, the field trip, Amy also enacted her racial identity by making a statement in regards to swimming in the Midwestern River. She simply states, “In case you’re wondering, I’m Black”. In her way, Amy demonstrates that this aspect of her racial identity will also affect her actions on the field trip, particularly if the canoe runs into some sort of trouble which would cause Amy and Jerome to land in the river.
Bailey also enacted her racial identity in different ways – both in the context of the classroom and in her arguments. In the context of the classroom, her racial identity involved a familiarity and comfort with people in her own race. This important part of her identity affected her classroom actions as found in her behavior in different groups. In her regular group which consisted of her African-American friends, Bailey was relaxed and laughing while creating arguments with her friends. However, during the town hall simulation where she was placed with three White students, her demeanor changed. Her approach to constructing the argument changed as well, with Bailey becoming more serious and quiet. Teachers should be made aware of the discomfort that students from various cultural groups may feel with each other or in the social context of the classroom. One way to circumvent this problem is to have teachers include a discussion that focuses on one NOS understanding, “science as a human endeavor” (NGSS, 2013, p. 6). Beginning in kindergarten, teachers should emphasize that individuals from all backgrounds and cultures “choose careers as scientists and engineers…and they work in teams” (NGSS, 2013, p. 6). Through activities beginning at an early age, students may then understand that such collaborations are typical in the field of science.

For participants that did enact their identities while constructing/evaluating arguments, these students did so by utilizing their lived experiences and other social identities. In terms of the actual construction of her arguments, Bailey demonstrates in one segment her concern of the price of organic vegetables for African-Americans and Mexicans. Again, her choice to identify the economic hardships of her racial group – based on her own experiences as a daughter and a student – helped to inform her scientific argument with her friends. In this case, the complex intersection of race, socio-
economic status, family, and school played roles in Bailey’s action or use of argumentation.

Brandy also enacted her racial identity in the evaluation of her arguments with the aid of other identity roles. In her interview, Brandy proudly discussed her Mexican neighborhood and the relationship between its Mexican and Black neighbors. In the evaluation of the argument, she included the economics relative to her neighborhood. Brandy chose to speak of money in disgust, asserting that money was not as important as the safety of the neighbors in a community. She based this assertion from her own lived experiences in her own community, where the promise of additional jobs and money from the construction of a new store in her neighborhood did not promise the safety of the citizens from increased crime and traffic. In her evaluation, a discussion of her community involved inclusion of her race and socioeconomic status as it related to her neighborhood and the various consequences associated with this – components that Hill Collins asserts constitutes the social location (2000).

April’s racist encounter in an AP classroom as a new student at Riverwest and the ways that she relied on her racial identity to react to this (described in Chapter 4) was in stark contrast to how she decided to enact her racial identity while engaging in argumentation. In both cases, however, she emphasizes her agency in expressing her identity. Her experience is one example of why critical theories involving race and gender, such as intersectionality theory, exist. For example, intersectionality theory premises that the intersections of race, class, and gender, etc. do result in certain populations holding a “privileged position with respect to other groups and offer individuals unearned benefits based solely on group membership” (Zambrana and Dill,
In April’s case, the White students in her class, by virtue of their group membership, benefitted from the academic rigors of the course. However, their treatment towards April due to her own group membership did not afford her the same benefits of a challenging education. April chose to react to this by asserting her agency when it came to attending the class, choosing instead to leave the class and attend a regular class where she could focusing on being the “best me”. However, her reconciling this situation does not eliminate the institutional factors that belies marginalized individuals such as April. In spite of this, when it came to constructing her scientific argument, April enacted a racial identity that presumed her race did not make April unique to other races when it came to the environmental concerns that affect all human beings. She used her agency to adopt a collective stance when constructing these arguments that were influenced by her own religious identity. This example demonstrates the way that she used her racial identity in the social context of the AP classroom versus the intersected roles of her religious and racial identities when it came to her use of argumentation.

5.2.1.2.2 Diversity.

Interviews uncovered other interesting views on race; and in doing so provided insight into how my participants viewed their racial identity in the context of Riverwest. Participants felt their race was not an issue at Riverwest, with others further explaining that the diversity of the school made it easier for them to have such perspectives. Studies on diversity and its impact on racial identity do exist. However, exploring diversity using an intersectionality and Black feminist lens is problematic. Studies that focus on intersectionality theory and diversity in education often discuss this topic as a way to draw attention to the various array of identities that fall in between certain traditional
categories of race, gender, and socioeconomic status. This has been extended to include the science classroom. Still, even using these definitions allows one to ascertain that the participants benefitted from the wide array of cultures found in Riverwest. Having a school that addressed diversity on several levels (e.g., special needs and sexuality) in ways that may have stretched the traditional social categories of race, gender, and socioeconomic status was something the participants seemed to appreciate in ways that promoted their learning. Consequently, the typical issues of inequality of power that intersectionality theory addresses was not apparent for these participants. This was probably aided by the teacher, who was an African-American male teacher who showed no biases toward male or female students in the class. Still these hegemonic issues undoubtedly exist at Riverwest, as April discusses in her first significant experience at Riverwest and as found in Bailey’s discomfort and assertion that, “Black people stick together here” – findings that contradict the other participants’ claims as well. These findings indicate that the participants represent a pool of students with their own unique experiences on race and diversity and that hegemonic influences still pervade the school system.

5.2.1.2.3 It’s about caring, othermothering, and more.

One of the important tenets Hill Collins promotes in her Black feminist framework involves an alternative epistemology where Black women understand and construct knowledge in ways that are not separate from their own standpoint (Hill Collins, 2000). Literature has already shown how this construction of knowledge does not exclude how black women construct scientific knowledge. Hill Collins demonstrates what this may mean in several ways with regards to Black women (2000). One way in
which she does this is by discussing how the construction of knowledge involves elements of caring, dialogue and lived experiences (Hill Collins, 2000). As mentioned above, evidence of caring occurred in my study either explicitly or implicitly when evaluating argumentation from the participants in this study. Othermothering as described in the previous chapter occurred throughout the study.

But, what does this really mean in the context of the science classroom? For instance, it is certain that the caring tenet is not limited to African-American girls. Indeed, Xavier, an African-American male in Bailey’s group, mentioned the need for people to care more about the environment frequently throughout the course of my study. Additionally, one need only to watch the news or read online media to see many instances of people from cultural groups all around the world use passion and caring to produce effective arguments. Commensurably, Hill Collins’ notion that knowledge is not value-free reaches in other areas outside of the Black feminist framework; with implications discussed throughout science education literature. One may also argue that the othermothering could easily be extended to any student – not just Black girls – as anyone can maintain an authoritative position.

However, studies that continue to offer insight into the multiplicity of identities that Black girls enact in a novel area of scientific literacy and discourse – scientific argumentation do not exist, at least not at the time this dissertation was written. The science discourse studies that headed the beginning of this new century, studies that were strongly influenced by the work of feminist philosophers of science – offered a unique and strongly needed perspective into the world of Black girls and science. Where Black girls with their own social location; vastly different from the classic binary distinction of
“being Black” or “being female” – the latter being indicative more of White females than Black, anyhow – were finally getting more than a mere glance in the area of science education. Even more, scholars were realizing that understanding how Black girls learn science was made more wonderfully complex by the various ways these young women chose to enact their identities. Science education seemed to be catching up to the work of Black feminist scholars outside of the area of science education – such as Hill Collins and bell hooks – who asserted for the need to use a different lens when viewing Black women; far different than the archaic additive factor found in older studies that attempted to understand this previously overlooked group. Crenshaw’s intersectionality theory was merely a necessary heuristic – a promptly timed tool – to propogate something that had been inherent in the lived experiences of Black women for centuries and discussed exhaustively in circles of Black feminist scholars. Sojourner Truth’s “Ain’t I a Woman” speech gives only a brief glimpse into the historically complex social locations of black women (Truth, 1851).

As a graduate student just embarking in the area of science education, I was still trying to understand my own science identity. I was still reeling from my own lived experiences that began as a child – where I was always a Black girl loving science but feeling as if science never loved me. When I began to read works from scholars such as Brickhouse et al. (2000) Calabrese Barton (1998) and Carlone and Johnson (2007), it seems almost minimalistic to state that their work motivated and inspired me. Most importantly, I felt encouraged and hopeful that other Black girls would begin to feel they were worthy of being in science and could even make vastly huge contributions with their crucial partial knowledges.
Fortunately, strides have occurred in one sense; with the authoring of the NGSS and the strong assertion that science educators develop culturally relevant approaches to reach a drastically changing population of students. In another sense, the research on Black girls has abruptly halted in the area of scientific argumentation. This is particularly disconcerting and disappointing because scientific argumentation in current years offers yet another interesting opportunity to view how Black girls rationalize the natural world. Hence, this study only offers an introduction into more studies that evaluate Black girls and how they rationalize the complex world of natural phenomena and socio-scientific topics. In this study, attempting to evaluate the lived experiences of these participants stemming from their own social location was one significant approach to facilitate more research into how these girls may construct and critique scientific arguments with their own partial knowledges. In this way, science education scholars could obtain a better understanding – having a richer, more robust picture of how scientific knowledge is constructed. A Black feminist lens certainly revealed that these participants offered unique ways into negotiating the arguments that occurred in their classroom. These girls relied on interesting aspects of their lives that included their family, religion, and even Montessorial and elementary environmental science. Even more, these participants showed the various ways they chose to enact their lived experiences. This study offers additional questions of the ways Black girls construct scientific knowledge by way of constructing and evaluating these arguments. For instance, how would this study have looked if these girls were explicitly taught an argumentation model that focuses on their lived experiences? The time to answer these questions could not come at a better time, with the implementation of NGSS beginning to make its mark in states all around the
United States. Such research that seeks to answer these complex questions must begin now.

5.3 Gatekeepers, and Multiplicity of Identities

This study revealed additional findings that warned of potential struggles for the ‘other’ student. In this study, the lived experiences of my participants revealed factors that could only be categorized as psycho-socio/cultural or pedagogical. These factors were reminiscent of the gatekeepers that Atwater (1996) has described in literature as well as Zambrana and Macdonald (2009), because I could visualize the potential negative impact these factors may have if not properly addressed in the classroom. In the field of science education and beyond, these factors have been addressed in some ways. However, it is difficult to find studies that address the specific factors that occurred in this study for these young Black women. For example, studies have focused on the structural barriers of home communities and linguistic challenges faced by students and how this impacts student learning and development of a science identity. However, such studies are typically located in the urban environments and bear the limitation of conflating Black girls and boys into one group. These studies do not address the Black girls or other marginalized individuals that choose to leave their urban communities to face the challenges of attending a large suburban high school. Studies have also focused on students that are placed in rural lower-track classrooms or explored learning disabilities in the science classroom, but not specifically geared to students that look like the students in my study. Although the participants in my study, like Darlene, developed coping strategies to help with her learning disabilities and obsessive-compulsive disorder; one must not assume that all students have the proper resources to live with these
challenges while attending school and learning science (NGSS, 2013; NRC, 2011). In Appendix D of the NGSS, which is titled “All Standards, All Students” (2013). In this appendix, NGSS lists case studies that provide examples of the various social groups in schools today. These case studies are presented to provide practical solutions for teachers in order to ensure an inclusive education.

economically disadvantaged students – 9th grade chemistry
students from major racial and ethnic groups – 8th grade life science
students with disabilities – 6th grade space science
students with limited English proficiency – 2nd grade earth science
girls – 3rd grade engineering
students in alternative education programs – 10th and 11th grade chemistry
gifted and talented students – 4th grade life science (Appendix D, NGSS, 2013, p. 3)

Although a remarkable piece of work that provides practical examples to teachers in various populations, one may still see how the NGSS itself lists groups of students as if they are homogenous. In actuality, these students’ backgrounds may reveal that they could categorically be placed in two or more of these groups. For example, Darlene would be a member in the “girls”, “students with disabilities”, and “students from major racial and ethnic groups” (NGSS, 2013, p. 3). Brandy would belong with the “economically disadvantaged students” as well as “girls” and “students from major racial and ethnic groups” (NGSS, 2013, p. 3). Consequently, current standards still point to the need for further analyses that relies on an intersectionality lens. In the case of Darlene, for example, her experiences as a Black female with special needs may be drastically different for a White female with her special needs in significant ways. Although using theoretical frameworks that reveal the multiplicity of identities is methodologically challenging, essentializing student groups also runs the risk of losing students in the data. These “lost” students could provide further insight into better ways of addressing a richly
diverse and unique group of students. Pedagogical strategies that prompt teachers to look
at each student as an individual with her own background and experiences may provide
the first steps needed to ensure an inclusive education.

5.4 Explicit and Open-ended Argumentation in the Classroom

In their study which assesses the use of argumentation in three classrooms,
McNeill and Pimentel (2010) found that when teachers adopted a more didactic approach
to teaching this practice, students were less likely to use various types of evidence.
Although some may define the term “didactic” to mean any instructional strategy
including “debates, role play, discussion, simulation, etc. (Simonneaux, 2001, p. 1),
McNeill and Pimentel distinguish this term from a more open-ended strategy, which
involves teachers facilitating argumentation-based discussions with open-ended questions
(2010). Indeed, as it relates to my study, the need for an open-ended approach to teaching
argumentation should not be understated. Although I noted Mr. J. typically integrating
open-ended questions in his argumentation-based activities, I also observed him missing
opportunities to engage students into developing argumentation-based skills due to his
didactic-centered shifts. Commensurably, I noticed opportunities where students would
benefit from an explicit model in argumentation in Mr. J.’s classroom. The McNeill and
Krajcik model is ideal in that it seems to follow a natural pattern in argumentation (2012).
In my study, students often used evidence to support their claims but had problems
providing an explanation – reasoning – for their use of evidence. Implementing a simple
model where students may practice argumentation using examples would provide a sound
basis to the argumentation-based activities a teacher presents in class. Students could then
be reminded of such a model (with corresponding examples) before beginning their
activity. Although Mr. J. was encouraged to use the model by a colleague who teaches biology at the school, spending a class period discussing the model rather than giving it to students as an additional resource would demonstrate the importance of this model to students. This allows for an easier way to assess how these students use arguments.

5.5 General Implications to Ensure a Science for All

Listed as one of eight practices that students must master along with important “core disciplinary ideas and crosscutting concepts[s]” (NGSS, 2013, p. 1), scientific argumentation is one significant way to engage students to scientific inquiry in their investigations. As the framework emphasizes, scientific argumentation as a practice of science

…helps students understand how scientific knowledge develops; such direct involvement gives them an appreciation of the wide range of approaches that are used to investigate, model, and explain the world…any education that focuses predominantly on the detailed products of scientific labor – the facts of science – without developing and understanding of how those facts were established or that ignores the many important applications of science in the world misrepresents science… (NRC, 2011, pp 42-43).

However, the need for culturally relevant approaches to ensure all students – such as the young Black women in my study – have the scientific knowledge and practices to engage in discussions and explanations related to our natural world is equally important. Studies that incorporate the necessary practices that K-12 students must master, with an in-depth look into students’ backgrounds and lived experiences using an alternative lens would be beneficial in providing a holistic picture of a student. This would bring educators one step closer to developing inclusive curricula or a rapidly-changing student population.

Teachers do not normally have the same cultural backgrounds of students – where educators are typically White and students are members of non-dominant groups or
special populations with other complex cultural, cognitive, and demographic differences. Hence, being able to model and teach argumentation in a variety of ways that will scaffold the learning of this important practice for these students is absolutely imperative and will continue to lead to transformative science education standards in this country. Even in classrooms where the teacher is similar in his/her racial background to the students, as in Mr. J.’s case, the classrooms still run the risk of relying on hegemonic practices of the institution which ignore the unique needs of certain populations of students. This leads to the cultural conflict students may face when reconciling the classroom culture with their own cultures.

Because important educational standards point to the need of “equity…. [to] be at the forefront… to support learning… for all students” (NRC, 2011, p. 277), this requires that pedagogical strategies be created that are used consistently by all K-12 teachers, to ensure an inclusive education. Figure 24 provides only one simple example of how this may be implemented in the classroom for an important scientific practice. However, classrooms differ all across the country. Because of this, professional development workshops and conference sessions have a lofty goal ahead – to design research that will allow scholars to first understand how to meet the needs of the “other” students that are becoming larger and larger in number. This will also include a thorough examination into the teachers’ original classroom practices and their own teaching philosophies, as well as the school’s philosophy on providing an inclusive education to all students, such as the Black girls in my study. The purpose of such professional development activities are so teachers may learn how to explicitly engage into revealing their lived experiences and social identities in a safe environment in order to properly develop culturally relevant
approaches for teaching an extremely important scientific practice. Even further, uncovering students’ multiple enacted identities will lead to additional novel ways of ensuring an inclusive education.

5.6 Limitations in the Study

This qualitative study had limitations that may have impacted some of the findings of the study. Time was a constraint in this study. The study took place over the course of only 8 weeks. During this time, Mr. J. did not use a significant number of argumentation-based activities. Because it was an exploratory study, my role was to obtain observations and not intervene with possible solutions to include argumentation-based activities. Consequently, I felt that I may have missed additional opportunities to capture data within these time constraints and under the control of Mr. J.’s curriculum.

Associated with the time constraints of the study were consequences related to the researcher effect. Although I noticed that the participants were beginning to adapt to my presence a couple of weeks into the study, a research project that is this short still runs the risk of students not acclimating to my presence. This seemed to be the case for at least one of my participants, Kylie, where I sensed a certain understandable mistrust of my role. However, other participants may have discussed topics with me in the interview in ways that they thought would provide a satisfying answer or they may have “performed” in class as well. However, instances where students felt comfortable enough to gossip and curse seemed to also assure me that the students had acclimated to my recording equipment and were, for the most part, being themselves.
5.7 Future Work

Because this study was considered a well-achieving school academically in comparison to neighboring schools, further exploratory studies are needed in schools where educational disparities are even more apparent – particularly urban and rural schools. Additionally, intervention or comparative studies that utilize an explicit argumentation model and curriculum that uncovers the lived experiences of students could be implemented in the classroom. An in-depth analysis could then reveal interesting findings that would inform future studies or practical pedagogical strategies. Studies could also explore other non-dominant groups. Indeed, my study revealed that including African-American male students may provide additional insight into novel pedagogical approaches. Future studies could also be broadened to include other scientific classroom practices and the ways students’ background and lived experiences may play a role in these processes.
REFERENCES


Lee, S., & Roth, W.-M. (2002). Learning science in the community. In Roth, W.M.
Désautels J. (Eds.), Science education for/as socio-political action (pp. 37–64). New York: Peter Lang.


MAXQDA (v. 10), software for qualitative data analysis, 1989-2015, VERBI Software – Consult – Sozialforschung GmbH, Berlin, Germany.


Pennock, P.H. & Schwartz, R. (2010). Using video clips to implement multicultural topics of science and nature of science into a biological content course for pre-service teachers – an action research project. *i.e. inquiry in education. 3*(2), 1-32.


Schoolmatters.com – Statistical information on schools in the United States of America.


Appendix A

Human Subjects Institutional Review Board Approval Form
Date: January 30, 2014

To: Ronie Schwartz, Principal Investigator
    Phyllis Haugabook Fennock, Student Investigator for dissertation

From: Amy Naugle, Ph.D., Chair

Re: HSIRB Project Number 14-01-19

This letter will serve as confirmation that your research project titled “African-American Girls and Scientific Argumentation: Intersecting Identities and their Role in Constructing and Evaluating Claims” has been approved under the expedited category of review by the Human Subjects Institutional Review Board. The conditions and duration of this approval are specified in the Policies of Western Michigan University. You may now begin to implement the research as described in the application.

Please note: This research may only be conducted exactly in the form it was approved. You must seek specific board approval for any changes in this project (e.g., you must request a post approval change to enroll subjects beyond the number stated in your application under “Number of subjects you want to complete the study.”) Failure to obtain approval for changes will result in a protocol deviation. In addition, if there are any unanticipated adverse reactions or unanticipated events associated with the conduct of this research, you should immediately suspend the project and contact the Chair of the HSIRB for consultation.

Reapproval of the project is required if it extends beyond the termination date stated below.

The Board wishes you success in the pursuit of your research goals.

Approval Termination: January 30, 2015
Appendix B

Interview Protocols
Interview with Amber

Hello. My name is Phyllis Haugabook Pennock. This interview is a part of the research project entitled “African-American Girls and Scientific Argumentation: Intersecting Identities and their Role in Constructing and Evaluating Claims.” The purpose of the study is to see how African-American girls use their own personal experiences in making and critiquing claims used in science. As part of this project, I will ask you questions concerning why you may have used certain claims or evidence in class. I will also ask about any of your own experiences that you may have used in your mind to help you make sense of some claims. Finally, I will show you different recorded events as they occurred in your classroom while you worked on different activities assigned in class with your fellow classmates and ask you to remark on what has occurred. This is so I can get a better understanding of what you did while you learned how to debate or make arguments in class. This interview will take about 40 minutes to complete and will be audio-recorded. Once I transcribe these interviews (write down what is being said), I will destroy the audiotapes to protect your identity.

All the information collected from you is confidential. That means your name or other identifying features will not be used in any analysis or in any reporting of the research. Your participation in this interview is voluntary. You may elect not to participate, to quit at any time during the interview, or to not answer certain questions, or to contact me should you decide that you do not want your responses included in the research. You may choose how much or how little you will participate without prejudice or penalty. In addition, the transcripts will be taken to my home and stored in a locked drawer in an office each day. Upon conclusion of the study, the data will be stored on a
CD and transported from the office to Western Michigan University by me. Federal regulations require that data be maintained in a locked file in the Primary Investigator’s office or in the University Archive for at least three years after the study closes.

The benefit for this type of research is that it will help provide different ways of teaching argumentation to different student populations, including those that are underrepresented in science. The only risks anticipated in this study are minor discomforts typically experienced by students like yourself when they are being observed or asked questions in a classroom setting (e.g., boredom, mild stress owing to various classroom and interview sessions). There may also be some mild stress associated with bringing up personal experiences. All of the usual methods employed during the interviews to alleviate any discomforts you may have will take place. This includes allowing time for you to answer each question during interviews and immediately stopping the interview should you not wish to continue. If an accidental injury occurs, appropriate emergency measures will be taken. In the case of an accident, please contact your safety personnel at 698-6700. If you need to talk to a school social worker, please call Darin Oliver at 698-9292.

Answer any questions. Ask if the participant would like to begin the interview. Thank the subject/participant and begin the interview.

- How old are you? What grade are you in?
- How many years have you been at Riverwest?
- Do you live close around here in the neighborhood? No need to tell me exactly, just want an idea of how close you feel to this community?
- Age, year in school, how many years in Riverwest?
• Are you involved in any extracurricular activities at Riverwest?

• What’s the overall climate or atmosphere like here? Is diversity valued? Are their cliques?

• Do you have any brothers and sisters? If so, how old? Both parents in household? Single parent? Good relationship with parents?

• Do you have a job? Why do you have one specifically?

• Do you take any other science courses?

• Overall, would you say you like science or not?

• Any career goals currently? I believe you mentioned Business?

• Now, I’m just going to ask you about certain things I noticed while I observed Mr. J’s class. Feel free to comment if you feel like it.

• How do you like environmental science class? What’s your opinion of it?

• Show clip from 9-11-2014-APES-KD-PS, discussing wolves. What are your overall impressions of the case studies presented, from your recollection? Do you feel comfortable presenting your viewpoints in class in light of the different topics in the case studies?

• Do you feel that these case studies are relatable to you? For instance? What about the other case study involving Chinese TakeOut? Did you feel knowing this is relevant to you and if your being shock was due to your past knowledge of turtles or experience?

• In the Zoo case study, in terms of if zoos should have an educational goal, you keep kept talking about how it would be necessary to make it fun too. Related to past experiences as a kid.
• You feel that the evolution debate should come to the zoo? You said this? Do you still feel this way?

• Is there anything in Mr. J’s class so far that struck you as interesting? Or something that could be relatable to your own life? If you could think of certain topics that would interest you, can you? Do you feel that you as young Black people value environmental science enough? What could make it so?

• Ask about the book review (. What was the name of the book that you reviewed? show the video clip titled) (PS-SummerBookReview-9-174thhourbackangleFIN)

• I’d like for you to give me your impression of the field trip and the assignment for the field trip. First I’ll just show you the video tape (Show 9-30KDPSPrepfortrip 6:30-10:00) and show corresponding audio (start at 7:30-10:03) and transcript if necessary.

• Were you clear on the assignment? How would you describe it? How were you told to relate the Claim-Evidence-Reasoning worksheet to this assignment? (show CER-R sheet)?

• Did you end up liking the field trip? Were you proud of yourself after that? (I feel that you should- you conquered a fear and you triumphed over it). Not many people can say they do that. What helped you with this trip?

• How did you feel about all the stuff that happened during the trip (residents calling the police on us, etc.)?

• You all read scripture. Do you remember what scriptures? Do you do this often? Do you consider yourself a religious person? Was this helpful for you on the trip?
• What caused you to change your experiment about assessing algae at different places throughout the trip to the turbidity one?

• Could you tell me about the last assignment that Mr. J assigned? The case study about the sheep? How did you interpret his instructions initially? What trumped you up with the instructions that made you come see him after school?

• How did your experiences in regards to the field trip or anything else so far this year (even though it’s only been a couple of months), how did this cause you to react to this case study?

• Do you like where you sit in class? Do you feel that this seating arrangement is beneficial for you in this class? Why or why not? In getting through the activities?
Interview with April

Hello. My name is Phyllis Haugabook Pennock. This interview is a part of the research project entitled “African-American Girls and Scientific Argumentation: Intersecting Identities and their Role in Constructing and Evaluating Claims.” The purpose of the study is to see how African-American girls use their own personal experiences in making and critiquing claims used in science. As part of this project, I will ask you questions concerning why you may have used certain claims or evidence in class. I will also ask about any of your own experiences that you may have used in your mind to help you make sense of some claims. Finally, I may show you different recorded events as they occurred in your classroom while you worked on different activities assigned in class with your fellow classmates and ask you to remark on what has occurred. This is so I can get a better understanding of what you did while you learned how to debate or make arguments in class. This interview will take about 40 minutes to complete and will be audio-recorded. Once I transcribe these interviews (write down what is being said), I will destroy the audiotapes to protect your identity.

All the information collected from you is confidential. That means your name or other identifying features will not be used in any analysis or in any reporting of the research. Your participation in this interview is voluntary. You may elect not to participate, to quit at any time during the interview, or to not answer certain questions, or to contact me should you decide that you do not want your responses included in the research. You may choose how much or how little you will participate without prejudice or penalty. In addition, the transcripts will be taken to my home and stored in a locked drawer in an office each day. Upon conclusion of the study, the data will be stored on a
CD and transported from the office to Western Michigan University by me. Federal regulations require that data be maintained in a locked file in the Primary Investigator’s office or in the University Archive for at least three years after the study closes.

The benefit for this type of research is that it will help provide different ways of teaching argumentation to different student populations, including those that are underrepresented in science. The only risks anticipated in this study are minor discomforts typically experienced by students like yourself when they are being observed or asked questions in a classroom setting (e.g., boredom, mild stress owing to various classroom and interview sessions). There may also be some mild stress associated with bringing up personal experiences. All of the usual methods employed during the interviews to alleviate any discomforts you may have will take place. This includes allowing time for you to answer each question during interviews and immediately stopping the interview should you not wish to continue. If an accidental injury occurs, appropriate emergency measures will be taken. In the case of an accident, please contact your safety personnel at 698-6700. If you need to talk to a school social worker, please call Darin Oliver at 698-9292.

*Answer any questions. Ask if the participant would like to begin the interview.*

*Thank the subject/participant and begin the interview.*

- How old are you? What grade are you in?
- Brothers and sisters?
- How many years have you been in Riverwest?
- Do you live close around here in the neighborhood? (How close do you feel about the community)
• Do you take part in any extracurricular activities?

• Do you have a job? Why do you have a job now in high school?

• Why did you choose to take an environmental science course? Any previous experiences that contributed to this? Or was there any interest of this before you joined the course?

• Do you take any other science courses? Have you?

• Any career goals?

• Now, I’m going to ask you specific questions about what I have observed in class (either audiotapes or videotapes). These are from transcripts from the Planet in Peril film

• In the first question for the overall discussion, it asks if environmentalists are successful? You said: I think they try and save the environment, saving the environment is there. They’re willing to save the environment and the species that are inside of it? You said: they also tried to stop poaching and hunting of the sharks and the other stuff we learned about in the video. because of their research with the polar bears and how they took the measures to do things on them to see how long they would be extinct. What did I say? I forgot! I said…oh, they bring awareness to, um, the animals that are on the brink of extinction. ..so that we can prevent that from happening.

• Do you still feel this way?

• Anything else you would like to add to about this? Were you aware of this before you watched the movie?

• In another question that asked about the responsibilities of individuals in managing natural resources, You said: We need natural resources so we should all be taking a part,
you also mentioned global warming is because of us, we should burn less fossil fuels? Do you still feel this way? How do you relate that to your own personal life?

- For another question, you said that the issues in the program relate to us in several ways. Adding to Kylie’s comment adding to Kylie’s viewpoint about if the environment changes then so would the ecosystems, etc. and you said that we would be vegetarians as well. Later on you mentioned “Well, because ice glaciers are melting at a faster rate and… and how they create flooding and it will affect us over hear. ‘Cause eventually, stuff that affects other countries could affect other countries… [connection to her own country] Do you find yourself thinking of these things as you go about your daily life?

- For the town hall simulation, you were in the friends of nature group. And you were also the first person to mention why you opposed the town hall simulation plan.

- You said: I oppose the plan, because, it may create more jobs for us, but it’s taking away the habitat of the animals. And the animals affect us so we don’t wanna mess up their habitat.

- Bottom line: Did you enjoy watching the movie? Did you learn anything that you had never learned before watching it? Do you think that any of the topics that you watched in the film or in this class so far can be related to your personal life, or was related to you but you never even knew it until now?

- Do you feel that all the things you learned thus far have a direct impact on you as an individual (as an African-American young woman) in your community? Does your identity as an African-American woman have anything to do with these issues at all?
Classroom dynamics:

- How did you feel working in such a diverse group, with Kylie, with one friend where English is a second language?
- How do you feel about working in different groups to complete your activities?
- Do you feel that you play an active role when engaging in this class (either in small group or classroom discussion)?
Interview with Bailey

Hello. My name is Phyllis Haugabook Pennock. This interview is a part of the research project entitled “African-American Girls and Scientific Argumentation: Intersecting Identities and their Role in Constructing and Evaluating Claims.” The purpose of the study is to see how African-American girls use their own personal experiences in making and critiquing claims used in science. As part of this project, I will ask you questions concerning why you may have used certain claims or evidence in class. I will also ask about any of your own experiences that you may have used in your mind to help you make sense of some claims. Finally, I may show you different recorded events as they occurred in your classroom while you worked on different activities assigned in class with your fellow classmates and ask you to remark on what has occurred. This is so I can get a better understanding of what you did while you learned how to debate or make arguments in class. This interview will take about 40 minutes to complete and will be audio-recorded. Once I transcribe these interviews (write down what is being said), I will destroy the audiotapes to protect your identity.

All the information collected from you is confidential. That means your name or other identifying features will not be used in any analysis or in any reporting of the research. Your participation in this interview is voluntary. You may elect not to participate, to quit at any time during the interview, or to not answer certain questions, or to contact me should you decide that you do not want your responses included in the research. You may choose how much or how little you will participate without prejudice or penalty. In addition, the transcripts will be taken to my home and stored in a locked drawer in an office each day. Upon conclusion of the study, the data will be stored on a CD and
Transported from the office to Western Michigan University by me. Federal regulations require that data be maintained in a locked file in the Primary Investigator’s office or in the University Archive for at least three years after the study closes.

The benefit for this type of research is that it will help provide different ways of teaching argumentation to different student populations, including those that are underrepresented in science. The only risks anticipated in this study are minor discomforts typically experienced by students like yourself when they are being observed or asked questions in a classroom setting (e.g., boredom, mild stress owing to various classroom and interview sessions). There may also be some mild stress associated with bringing up personal experiences. All of the usual methods employed during the interviews to alleviate any discomforts you may have will take place. This includes allowing time for you to answer each question during interviews and immediately stopping the interview should you not wish to continue. If an accidental injury occurs, appropriate emergency measures will be taken. In the case of an accident, please contact your safety personnel at 698-6700. If you need to talk to a school social worker, please call Darin Oliver at 698-9292.

Answer any questions. Ask if the participant would like to begin the interview. Thank the subject/participant and begin the interview.

- How old are you? What grade are you in?
- How many years have you been at Riverwest?
- Do you live close around here in the neighborhood? No need to tell me exactly, just want an idea of how close you feel to this community?
- Age, year in school, how many years in Riverwest?
• Are you involved in any extracurricular activities at Riverwest?
• Do you have any brothers and sisters? If so, how old?
• I heard you also have a job? I know this sounds like a stupid question, because I worked at BK when I was in high school for my own reasons. But, why do you have a job specifically?
• Do you take any other science courses?
• Overall, would you say you like science or not? How about environmental science?
• Any career goals currently?
• Now I’m going to ask you specific questions relating to what I observed over the last couple of months with you, while I was in class, on the audiotapes and videotapes. Again, if you feel uncomfortable at any time, just tell me to shut up, OK?
• Ok, going WAY back to that Planet in the Peril film, you were having an interesting discussion about this with Xavier and AM. (Read part of the transcript where she talks about the fact that they don’t CARE about the environment—Pull up 2nd HourRESBL It’s underlined. Do you want to talk more about that? You were mentioning that environmentalists’ role are not successful, really, because there are not enough people. Anything else you want to mention about that?
• You also bring up that oil spills in other countries affect us as well. Do you want to tell me what you mean by that? (Read in transcript on iPages)
• Related to that, you mentioned that you went to a school related to environmental science? When did you do that? Do you relate any of that to what you’re learning in class?
• Back to how you relate with your friends (Xavier and AM etc.) at the table, do you find it enjoyable or not so much debating certain topics in class with them? Do you overall feel that you offer insightful perspectives to your friends and your classmates? Pull up 2nd hourRES9-18

• You still remarked at times that you could not understand why people would want to live in that sort of habitat with woods and rivers, away from people but more with animals. Why?

• You were for the building of the lumber mill. Why?

• How did you feel being put into a new group where you had to give your own opinions? (Pull up county commisionersPartIsimulationinDropbox)

• When you discussed it with the county commissioners, I interrupted and reminded your group that you could discuss until you come to a conclusion. I also noticed that the county commissioners that were against the lumber mill gave their viewpoint and you said OK. Why did you decide that the lumber mill didn’t need to be built? (Pull up countycommissioners2ndhourTHS.mps)

• Has being in this class uncovered any sort of topics that you were not passionate about before but are now?

• If you could do something to make this class more engaging to debate certain issues, what would they be?
Interview with Brandy

Hello. My name is Phyllis Haugabook Pennock. This interview is a part of the research project entitled “African-American Girls and Scientific Argumentation: Intersecting Identities and their Role in Constructing and Evaluating Claims.” The purpose of the study is to see how African-American girls use their own personal experiences in making and critiquing claims used in science. As part of this project, I will ask you questions concerning why you may have used certain claims or evidence in class. I will also ask about any of your own experiences that you may have used in your mind to help you make sense of some claims. Finally, I may show you different recorded events as they occurred in your classroom while you worked on different activities assigned in class with your fellow classmates and ask you to remark on what has occurred. This is so I can get a better understanding of what you did while you learned how to debate or make arguments in class. This interview will take about 40 minutes to complete and will be audio-recorded. Once I transcribe these interviews (write down what is being said), I will destroy the audiotapes to protect your identity.

All the information collected from you is confidential. That means your name or other identifying features will not be used in any analysis or in any reporting of the research. Your participation in this interview is voluntary. You may elect not to participate, to quit at any time during the interview, or to not answer certain questions, or to contact me should you decide that you do not want your responses included in the research. You may choose how much or how little you will participate without prejudice or penalty. In addition, the transcripts will be taken to my home and stored in a locked drawer in an office each day. Upon conclusion of the study, the data will be stored on a
CD and transported from the office to Western Michigan University by me. Federal regulations require that data be maintained in a locked file in the Primary Investigator’s office or in the University Archive for at least three years after the study closes.

The benefit for this type of research is that it will help provide different ways of teaching argumentation to different student populations, including those that are underrepresented in science. The only risks anticipated in this study are minor discomforts typically experienced by students like yourself when they are being observed or asked questions in a classroom setting (e.g., boredom, mild stress owing to various classroom and interview sessions). There may also be some mild stress associated with bringing up personal experiences. All of the usual methods employed during the interviews to alleviate any discomforts you may have will take place. This includes allowing time for you to answer each question during interviews and immediately stopping the interview should you not wish to continue. If an accidental injury occurs, appropriate emergency measures will be taken. In the case of an accident, please contact your safety personnel at 698-6700. If you need to talk to a school social worker, please call Darin Oliver at 698-9292.

*Answer any questions. Ask if the participant would like to begin the interview. Thank the subject/participant and begin the interview.*

- How old are you? What grade are you in?
- How many years have you been at Riverwest?
- Do you live close around here in the neighborhood? No need to tell me exactly, just want an idea of how close you feel to this community?
- Age, year in school, how many years in Riverwest?
• Are you involved in any extracurricular activities at Riverwest?

• Do you have any brothers and sisters?

• I heard you also have a job? I know this sounds like a stupid question, because I worked at BK when I was in high school for my own reasons. But, why do you have a job specifically?

• Do you take any other science courses? I noticed you took AP Biology from Warfield subbing for Mr. V

• Overall, would you say you like science or not? How about environmental science?

• Any career goals currently?

• There are several instances in the planet in the peril film that seemed to hold your interest. Zoonotic viruses in PIP, for example and you answered as such. Did you feel that you were able to concentrate OK in your original seating chart? (Next LB) 9-12 field notes

• In the town hall simulation where you discussed your role as citizens of nature? (Play BW and Javnote at starts 1:39 on iPhone – 10-6 –also show videotape which is found in spars-ices – 10-6-citizens in Drop box in internet.) You mention that you’re for it because of the jobs but then against it because of all the commotion, etc. from the community reaction and you said that you are between both of them. Was there anything about this issue that resonated with you in your own life? Mr. J in his instructions stated that you should feel free to think of your own experiences. Did you think that was necessary?

• You insisted that Mena read the issue in totality when she joined. Why was that important to you?
• How about after the town hall simulation. Was there anything that swayed your opinion that stood out? Did your experiences relate to it?

• Pull out the “Be and mw” from iPhone that begins at 5:22 (I just didn’t hear what someone said about racism? Could you help me with this?

Classroom dynamics

• Do you feel, overall, that your voice is heard in the classroom when you are discussing certain issues (both in small group and large group)? Would you prefer small or large group discussion?

• Put up AB-BW-PIP-presentation video – How did you feel about being designated as presenting? Did you overall agree with what was presented? Show White board and transcript (BW-AB-9-25) video. Could you relate to any of it?
Interview with Darlene

Hello. My name is Phyllis Haugabook Pennock. This interview is a part of the research project entitled “African-American Girls and Scientific Argumentation: Intersecting Identities and their Role in Constructing and Evaluating Claims.” The purpose of the study is to see how African-American girls use their own personal experiences in making and critiquing claims used in science. As part of this project, I will ask you questions concerning why you may have used certain claims or evidence in class. I will also ask about any of your own experiences that you may have used in your mind to help you make sense of some claims. Finally, I may show you different recorded events as they occurred in your classroom while you worked on different activities assigned in class with your fellow classmates and ask you to remark on what has occurred. This is so I can get a better understanding of what you did while you learned how to debate or make arguments in class. This interview will take about 40 minutes to complete and will be audio-recorded. Once I transcribe these interviews (write down what is being said), I will destroy the audiotapes to protect your identity.

All the information collected from you is confidential. That means your name or other identifying features will not be used in any analysis or in any reporting of the research. Your participation in this interview is voluntary. You may elect not to participate, to quit at any time during the interview, or to not answer certain questions, or to contact me should you decide that you do not want your responses included in the research. You may choose how much or how little you will participate without prejudice or penalty. In addition, the transcripts will be taken to my home and stored in a locked drawer in an office each day. Upon conclusion of the study, the data will be stored on a CD and transported from the office to Western Michigan University by me. Federal
regulations require that data be maintained in a locked file in the Primary Investigator’s office or in the University Archive for at least three years after the study closes.

The benefit for this type of research is that it will help provide different ways of teaching argumentation to different student populations, including those that are underrepresented in science. The only risks anticipated in this study are minor discomforts typically experienced by students like yourself when they are being observed or asked questions in a classroom setting (e.g., boredom, mild stress owing to various classroom and interview sessions). There may also be some mild stress associated with bringing up personal experiences. All of the usual methods employed during the interviews to alleviate any discomforts you may have will take place. This includes allowing time for you to answer each question during interviews and immediately stopping the interview should you not wish to continue. If an accidental injury occurs, appropriate emergency measures will be taken. In the case of an accident, please contact your safety personnel at 698-6700. If you need to talk to a school social worker, please call Darin Oliver at 698-9292.

*Answer any questions. Ask if the participant would like to begin the interview. Thank the subject/participant and begin the interview.*

- How old are you? What grade are you in?
- How many years have you been at Riverwest?
- Do you live close around here in the neighborhood? No need to tell me exactly, just want an idea of how close you feel to this community?
- Age, year in school, how many years in Riverwest?
• Are you involved in any extracurricular activities at Riverwest?
• Do you have any brothers and sisters?
• Do you also have a job? I know this sounds like a stupid question, because I worked at BK when I was in high school for my own reasons. But, why do you have a job specifically?
• Do you take any other science courses?
• Overall, would you say you like science or not? How about environmental science?
Could you tell me more about your mentoring relationship with Mr. J in the past and present? How do you like his teaching style, etc.?
• Any career goals currently?
• Now I’m going to ask you about specific things that I’ve observed in Mr. J’s class with you and feel welcome to response. If I’m too intrusive, please ask me to decline.
• Do you remember any of the particular issues that were discussed that stood out for you or that held your interest from PIP?
• A long time ago when your group was assigned questions for the Planet in the Peril film (show video as a reminder), you worked with Tia and Kevin and another gentleman. Do you recall this conversation?
• Here are the talking points based on the question: Bush meat and Zoonotic Viruses:
• What are some of the negative impacts of hunting bush meat on the local ecology? Do you think these environmental concerns should outweigh the demand for food in these villages? Explain.
• What are some factors that might cause an increase in the spread of zoonotic viruses? What are some methods Dr. Nathan Wolfe has used to stop the spread of zoonotic viruses?
In your opinion, how might scientists and policymakers prevent the spread of these diseases.

• Here was the presentation that you essentially presented on after discussing it fully in the group: (Pull up 1sthourPIPPresentation9-22partIII.) How was it working with them as a group? Do you recall? I didn’t hear that you volunteered a lot in the conversation. Did
you agree with their opinions (the males were mostly speaking?) Was there a reason for that?

- Town Hall Simulation County Commissioners –10-7 town of commissioners meeting (VERY POOR AUDIO)

- What were your overall thoughts about this assignment? Read comments to remind her.

- Transcript excerpt for notes: Mr. J.: Hey guys, who weren’t here yesterday?
  
  OK, you guys got UNTIL…(looking at the clock)….7:55! To finish up your statements and then we’re going to do something different.

  2:15 Mr. J. talking to some students in the background but inaudible.

  The front one doesn’t really fit our thing.
Mr. J: Come on guys, let’s go, otherwise I’m pulling my time back, cause you need it.

Kevin: (inaudible)

Carolyn: We could describe what we’re listing to from both ends, so that we’re aware that one side of this, and that the other side is a completely different thing.

Blonde fm: We could.

DA: Yeah, and like say they’re only listing things such as COSTS and BENEFITS…and (doesn’t finish, just trails off)

4:05 - Silence for awhile.

Students are discussing how many times they go up the front and remembered it was four, but hard to understand who is saying what.

DA: Do you guys know like, what we’re suppose to say?

Af-Am male: We’re suppose to go four times.

DA: (somewhat insistent) So what are we all suppose to say? That’s what I don’t understand.

BG: WHY like, you know how we have to go up four times each? Like, what are we suppose to say when we go up?

WB: We gotta go up four times too?

BG: Yeah (says quickly).

DA asks someone if they were here yesterday and the White girl says no, and DA says…”Well, you gotta go so, you gotta get the group, you gotta go, get the like….”
5:21: K: (inaudible) I don’t know (lifting up voice on know). That’s what I’m talking about.

5:51 Someone goes up and asks Mr. J. She comes back.

BG: (after coming back). We ask the questions! Guys.

WB: What’s that?

BG: We ask the questions. Like, say somebody does says that taxpayers pay for the…

WB: Yeah. (prompting her).

BG: Construction (saying quickly). And we can get up and sayy, (inaudible) taxes (inaudible) isn’t only affect people in the community? Oooor…like, how much is it gonna affect? You know? Like ask questions.

WB: But we ask on (inaudible), you know based on (inaudible).

BG: Or if one of us wants to say, uh, “That was just a strong argument (drawn out on argument), half of us commissioners, we agree with thaat. Um, but the other side may argue as well, so we wanted you to know that…or something like that.

6:41 Silence for awhile.

Inaudible talk about tax but heard DA mention something first and then blonde girl mentioned something.

7:00 DA: My coffee spilled hard to hear her. Goodness!

WG: If someone uses an argument like we HAD, (inaudible), it’s harder to present.

DA: I feel like we’re going to stomp them in terms of a few positions.

WG: Stomp?
DA: inaudible

Can hear Mr. J. talking about collecting about chapter view.

WB: (inaudible)

WG: This one?

WB: (Inaudible)

WG: This one is, um, friends of nature. This one is…

WG: Can I just check this for a sec?

Female: Sure. I still have no (inaudible).

9:11 –Just hear students talking in the background.

BG is giving instructions to someone at what to read but not sure if this is another assignment. They are not talking much.

DA: We should, like, write down a list of questions. [CD: Offering input for Argument simulation as County Commissioners]

BG: Hmmm?

DA: Like, we should write down a list of questions.

BG: Do you guys want to write down, like a list of questions we should ask?

WB: yeah

DA: (inaudible)... want to just write it down on another piece?

BG: I got the paper (saying quickly).

DA: These are our questions, right?

BG: Yep.

DA: Yeah, we got the questions right here. We got questions paper

WB: Oh.
WG: So (inaudible) against it, not for it.

11:36 Silence

DA: (she talks so softly) Say, if we you have a low budget, how would you build it? [CD: Offering input for Argument simulation as County commissioners]

BG: Um…we could say…wait, when you guys read the article?(lifts her voice on –cle), did it say the GOVERNMENT was in it too?

WB: The what?

BG: The government was in it? Was it just the people against it?

WG: It was just the people.

BG: So, for the people that are for it…we could say, like, how do you guys plan on getting the government’s view on this….like how do you guys plan on having it step them step in as well. (inaudible question after this)

WB: Yeah.

KS: inaudible

WB: What’s that?

KS: Inaudible

BG: What else could we ask?

13:02 DA (talks in a soft voice): I mean, cuz they ARE chopping down a lot of trees. Chopping down all these trees (can’t tell if she just didn’t finish or if it’s inaudible)

Table is silently writing

14:00 BG: What else could we ask?

WB: Um, are we actually just one group or (inaudible) groups?
Blonde girl: Um, we’re going up before, and then who’s for…and then who’s against them.

WB: Ooooh…geez.

DA: Did you guys have anything?

WB: I did say the profit for (inaudible) town.

DA: Huh?

WB: I did say the profit for (inaudible) town. *Only slightly louder.*

DA: Did it?

WG: Is this FOR it?

WB: If it doesn’t say anything about that? We could say “What do you (inaudible)

BG: We could say, wait (inaudible)

WB: Well, yeah, pay money for the campgrounds.

DA: Huh?

WB: You gotta pay money to camp there (repeating but with a slight lift to his voice).

BG: So we could say, when you get that profit, where would it go?

WB: Yeah. But you should see first if it says it IN there. Where they say the profit will go.

WG: I actually don’t think it says it in here.

WB: Alright then. You can say it as a question.

Students flipping papers.
Mr. J. makes an announcement (contextualization cue) to finish chapter questions. States that they have the rest of the hour to do this, but they need a signature from him on C. 1 Test review.

Students start talking louder now.

DA: What?? Are you serious? To Mr. J’s assignment

The students have totally disregarded discussing the town hall simulation and are now talking about the homework that is due. DA says “We are screwed” and WG says: there’s no way that we can answer these 17:07 questions because we need more information for them.

BG: He only wants 1-28? That’s it.

DA: Half of them, you can’t even ANSWER (voice is finally loud and higher during this time, sounds stressed) Even like the review, you know the packet he had us do, in the packet that he had….

WG: yeah

DA: I couldn’t answer half of those questions, I was like “Where’s this coming from? Where’s this question coming from?” (stopped at 17:23)

Students start talking about all of the questions and homework that is due. DA is talking about is discussing this with the rest of the table. They sound upset as well as DA. Students are sharing the heavy workload. Spends rest of the time working fervently on this.

- Present audio beginning at 1:49-4:20 (10-RES1sthourCountyCommisionerDecision

372
• Show her the beginning of THS10-81sthourRES (their position statement begins at around 1:00). Did you feel the same way as this? Is the typical way to weight out decisions? How would you describe it?

• Do you feel that anything about this simulation (as Mr. J related it to his) relates to anything about your experiences? How about PIP?

• How did you feel about working in this group compared to the group that you worked in with PIP.

• You were placed in a large group awhile ago when you were discussing the Geosphere. The question your group had to address was whether or not you agreed or disagreed with the following statement. Because scientists are unable to predict when and precisely where an earthquake will occur, the government has a duty to issue building codes to ensure that all structures can withstand earthquakes. The group seemed to all agree, did you? Did you find this topic interesting? Play position statement at 1sthour10-22BWABDA. Begin at 26:50…Did you agree?

Health Questions

• Awhile ago, you mentioned that you liked to wash your hands a lot. You also mentioned other things that I’m not sure you really wanted me to remember (because it was in passing), but I did. Do you mind if I ask you some personal questions?

• You mentioned that you have to wash your hands a lot? How does this affect you in school?

• You mentioned that you require a longer time to take tests. For how long? How does this affect this in school?

Classroom/School dynamics
• How do you feel about the pace of the class and working with Mr. J.?

• Do you feel, overall, that your voice is heard in the classroom when you are discussing certain issues (both in small group and large group)? Would you prefer small or large group discussion?

• How do you feel about the make-up of the class in general compared to how you fit in? Do you feel any differences with certain make-up of groups?
Interview with Janice

Hello. My name is Phyllis Haugabook Pennock. This interview is a part of the research project entitled “African-American Girls and Scientific Argumentation: Intersecting Identities and their Role in Constructing and Evaluating Claims.” The purpose of the study is to see how African-American girls use their own personal experiences in making and critiquing claims used in science. As part of this project, I will ask you questions concerning why you may have used certain claims or evidence in class. I will also ask about any of your own experiences that you may have used in your mind to help you make sense of some claims. Finally, I may show you different recorded events as they occurred in your classroom while you worked on different activities assigned in class with your fellow classmates and ask you to remark on what has occurred. This is so I can get a better understanding of what you did while you learned how to debate or make arguments in class. This interview will take about 40 minutes to complete and will be audio-recorded. Once I transcribe these interviews (write down what is being said), I will destroy the audiotapes to protect your identity.

All the information collected from you is confidential. That means your name or other identifying features will not be used in any analysis or in any reporting of the research. Your participation in this interview is voluntary. You may elect not to participate, to quit at any time during the interview, or to not answer certain questions, or to contact me should you decide that you do not want your responses included in the research. You may choose how much or how little you will participate without prejudice or penalty. In addition, the transcripts will be taken to my home and stored in a locked drawer in an office each day. Upon conclusion of the study, the data will be stored on a CD and transported from the office to Western Michigan University by me. Federal regulations require that data be maintained in a locked file in the Primary Investigator’s office or in the University Archive for at least three years after the study closes.

The benefit for this type of research is that it will help provide different ways of teaching argumentation to different student populations, including those that are underrepresented in science. The only risks anticipated in this study are minor
discomforts typically experienced by students like yourself when they are being observed or asked questions in a classroom setting (e.g., boredom, mild stress owing to various classroom and interview sessions). There may also be some mild stress associated with bringing up personal experiences. All of the usual methods employed during the interviews to alleviate any discomforts you may have will take place. This includes allowing time for you to answer each question during interviews and immediately stopping the interview should you not wish to continue. If an accidental injury occurs, appropriate emergency measures will be taken. In the case of an accident, please contact your safety personnel at 698-6700. If you need to talk to a school social worker, please call Darin Oliver at 698-9292.

Answer any questions. Ask if the participant would like to begin the interview. Thank the subject/participant and begin the interview:

- How old are you? What grade are you in?
- How many years have you been at Riverwest?
- Do you live close around here in the neighborhood? No need to tell me exactly, just want an idea of how close you feel to this community?
- Age, year in school, how many years in Riverwest?
- Are you involved in any extracurricular activities at Riverwest?
- Do you have any brothers and sisters?
- Do you also have a job? I know this sounds like a stupid question, because I worked at BK when I was in high school for my own reasons. But, why do you have a job specifically?
- Do you take any other science courses?
- Overall, would you say you like science or not? How about environmental science?

Could you tell me more about your mentoring relationship with Mr. J in the past and present? How do you like his teaching style, etc.?
• Any career goals currently?

• Now I’m going to ask you about specific things that I’ve observed in Mr. J’s class with you and feel welcome to response. If I’m too intrusive, please ask me to decline.

• Do you remember any of the particular issues that were discussed that stood out for you or that held your interest from PIP?

• A long time ago when your group was assigned questions for the Planet in the Peril film (show video as a reminder), you worked with Darlene and Kevin and another gentleman. Do you recall this conversation?

• Here are the talking points based on the question: Bush meat and Zoonotic Viruses:

  • What are some of the negative impacts of hunting bush meat on the local ecology? Do you think these environmental concerns should outweigh the demand for food in these villages? Explain.
• What are some factors that might cause an increase in the spread of zoonotic viruses?

What are some methods Dr. Nathan Wolfe has used to stop the spread of zoonotic viruses?

In your opinion, how might scientists and policymakers prevent the spread of these diseases.

- Some animals carry zoonotic viruses, and people eat the animals, then travel to different countries.
- The kind of animals they kill.
- No, because humans are more important than animals.
- The humans should be more specific of what animals they kill and eat.
- The reason is because humans are getting sick by some animals they eat.

8.
- Some of these animals are the only thing people want to eat.
- Doctor Nathan uses filter papers to check what type of viruses the animals carry.
- People need to be aware of what they eat and take care of their health.
Here was the presentation that you essentially presented on after discussing it fully in the group: Pull up 1sthourPIPPresentation9-22partIII. How was it working with them as a group? Do you recall? Did you agree with their opinions? Who mostly spoke during this time? Was there a reason for that?

Town Hall Simulation
Friends of Nature
- Pull up 10-6/first hour/friends of nature with JJ to get video (corresponding audio is stresijabfontownsimulation10-6_2014_10_06.mp3)
- Please listen to AB-JJ1sthrRESFONtown (on 10-7 in Drop box). Corresponding video is at fon10-7abjj1stres.mp3
- Why did you decide to be in this group?
- What are you doing in this group?
- Give her the position statement. When the position statement says that it will end up being crowded, noisy, and polluted and other things. How did you come up with this statement?
- Before hearing a situation such as this in environmental science class, had you heard of this before?
- Look at town hall simulation THS10-81sthrRES. I noticed that you did not have the opportunity to go up to present. Were you there? Is this because of your own choice or time constraints or some other reason? Do you recall what your position was at this particular time?
- Pull up audio for 10-22 (Only posted pics accidentally: C:\Users\Phyllis\Dropbox\dissertation\sparsices\Observation and Corresponding
Hard time to hear if you responded though I have some pics with your earphones in your ears. Thought I heard voice. True or not?

- 12:23 – Do you agree with money? Were you asked that? What did you say?
- What did you say if I didn’t hear or what would you say if I didn’t.

Classroom/School dynamics

- Overall, do you feel as if there were issues that you would be interesting to address different your own unique background with race, gender, your own interests and life experiences?
- How do you feel about the pace of the class and working with Mr. J.?
- Do you feel, overall, that your voice is heard in the classroom when you are discussing certain issues (both in small group and large group)? Would you prefer small or large group discussion?
- How do you feel about the make-up of the class in general compared to how you fit in? Do you feel any differences with certain make-up of groups?
Interview with Kylie

Hello. My name is Phyllis Haugabook Pennock. This interview is a part of the research project entitled “*African-American Girls and Scientific Argumentation: Intersecting Identities and their Role in Constructing and Evaluating Claims.*” The purpose of the study is to see how African-American girls use their own personal experiences in making and critiquing claims used in science. As part of this project, I will ask you questions concerning why you may have used certain claims or evidence in class. I will also ask about any of your own experiences that you may have used in your mind to help you make sense of some claims. Finally, I will show you different recorded events as they occurred in your classroom while you worked on different activities assigned in class with your fellow classmates and ask you to remark on what has occurred. This is so I can get a better understanding of what you did while you learned how to debate or make arguments in class. This interview will take about 40 minutes to complete and will be audio-recorded. Once I transcribe these interviews (write down what is being said), I will destroy the audiotapes to protect your identity.

All the information collected from you is confidential. That means your name or other identifying features will not be used in any analysis or in any reporting of the research. Your participation in this interview is voluntary. You may elect not to participate, to quit at any time during the interview, or to not answer certain questions, or to contact me should you decide that you do not want your responses included in the research. You may choose how much or how little you will participate without prejudice or penalty. In addition, the transcripts will be taken to my home and stored in a locked drawer in an office each day. Upon conclusion of the study, the data will be stored on a
CD and transported from the office to Western Michigan University by me. Federal regulations require that data be maintained in a locked file in the Primary Investigator’s office or in the University Archive for at least three years after the study closes.

The benefit for this type of research is that it will help provide different ways of teaching argumentation to different student populations, including those that are underrepresented in science. The only risks anticipated in this study are minor discomforts typically experienced by students like yourself when they are being observed or asked questions in a classroom setting (e.g., boredom, mild stress owing to various classroom and interview sessions). There may also be some mild stress associated with bringing up personal experiences. All of the usual methods employed during the interviews to alleviate any discomforts you may have will take place. This includes allowing time for you to answer each question during interviews and immediately stopping the interview should you not wish to continue. If an accidental injury occurs, appropriate emergency measures will be taken. In the case of an accident, please contact your safety personnel at 698-6700. If you need to talk to a school social worker, please call Darin Oliver at 698-9292.

*Answer any questions.* *Ask if the participant would like to begin the interview.* *Thank the subject/participant and begin the interview.*

- How old are you? What grade are you in?
- How many years have you been at Riverwest?
- Do you live close around here in the neighborhood? No need to tell me exactly, just want an idea of how close you feel to this community?
- Age, year in school, how many years in Riverwest?
• Are you involved in any extracurricular activities at Riverwest?

• Do you have any brothers and sisters? If so, how old? From the audio, I think you said your parents were divorced.

• I heard you also have a job? I know this sounds like a stupid question, because I worked at BK when I was in high school for my own reasons. But, why do you have a job specifically?

• Do you take any other science courses?

• Overall, would you say you like science or not?

• Any career goals currently?

• Now, I’m just going to ask you about certain things I noticed while I observed Mr. J’s class. Feel free to comment if you feel like it. But of course, you don’t have to. Although, I don’t think I’m getting all in your business, I can’t get inside of your head, so please feel free to tell me to shut up.

• Ask about the book review (. What was the name of the book that you reviewed?

show the video clip titled KDsummerbookreview on 9-15)

• How do you like environmental science class? What’s your opinion of it?

• Show clip from 9-11-2014-APES-KD-PS, discussing wolves. Did you find this relatable to you or interesting?

• Is there anything in Mr. J’s class so far that struck you as interesting? Or something that could be relatable to your own life?

• I’ve noticed several times in the course that you are not comfortable with all this scientific lingo. For instance, the day before the field trip when you asked what “macro-
invertebrates” were. Do you feel that a lot in the class, some of the time, or really not that much?

- Did you end up liking the field trip? Were you proud of yourself after that? (I feel that you should- you conquered a fear and you triumphed over it). Not many people can say they do that. What helped you with this trip? (You made comments to Mr. J. that you didn’t feel ready subject wise and also that you were scared of the water?)

- How did you feel about all the stuff that happened during the trip (residents calling the police on us, etc.)?

- I remember Amber saying that you all read scripture? Is that for real? Did this help in any way? Do you feel comfortable talking about how you felt facing the water? I also notice you like to sing a lot (you’re a great singer). Does that help you in any way in this class?

- In your presentation, you also mentioned that you didn’t want to be there, so in future trips, you would have done things differently on the trip. What did you mean by that? What caused you to change your experiment about assessing algae at different places throughout the trip to the turbidity one? In video clip kyliefieldtrippresentation10-20 but audio go to 40:30 minutes for her.

- Could you tell me about the last assignment that Mr. J assigned? The case study about the sheep? How did you interpret his instructions initially? What trumped you up with the instructions that made you come see him after school?

- How did your experiences in regards to the field trip or anything else so far this year (even though it’s only been a couple of months), how did this cause you to react to this case study?
- Was there any sort of topic that has been explored so far this year that intrigued you?
- If you could talk about any particular topic in this class (in the context of this class), what do you think it would be?
Interview with Maya

Hello. My name is Phyllis Haugabook Pennock. This interview is a part of the research project entitled “African-American Girls and Scientific Argumentation: Intersecting Identities and their Role in Constructing and Evaluating Claims.” The purpose of the study is to see how African-American girls use their own personal experiences in making and critiquing claims used in science. As part of this project, I will ask you questions concerning why you may have used certain claims or evidence in class. I will also ask about any of your own experiences that you may have used in your mind to help you make sense of some claims. Finally, I may show you different recorded events as they occurred in your classroom while you worked on different activities assigned in class with your fellow classmates and ask you to remark on what has occurred. This is so I can get a better understanding of what you did while you learned how to debate or make arguments in class. This interview will take about 40 minutes to complete and will be audio-recorded. Once I transcribe these interviews (write down what is being said), I will destroy the audiotapes to protect your identity.

All the information collected from you is confidential. That means your name or other identifying features will not be used in any analysis or in any reporting of the research. Your participation in this interview is voluntary. You may elect not to participate, to quit at any time during the interview, or to not answer certain questions, or to contact me should you decide that you do not want your responses included in the research. You may choose how much or how little you will participate without prejudice or penalty. In addition, the transcripts will be taken to my home and stored in a locked drawer in an office each day. Upon conclusion of the study, the data will be stored on a
CD and transported from the office to Western Michigan University by me. Federal regulations require that data be maintained in a locked file in the Primary Investigator’s office or in the University Archive for at least three years after the study closes.

The benefit for this type of research is that it will help provide different ways of teaching argumentation to different student populations, including those that are underrepresented in science. The only risks anticipated in this study are minor discomforts typically experienced by students like yourself when they are being observed or asked questions in a classroom setting (e.g., boredom, mild stress owing to various classroom and interview sessions). There may also be some mild stress associated with bringing up personal experiences. All of the usual methods employed during the interviews to alleviate any discomforts you may have will take place. This includes allowing time for you to answer each question during interviews and immediately stopping the interview should you not wish to continue. If an accidental injury occurs, appropriate emergency measures will be taken. In the case of an accident, please contact your safety personnel at 698-6700. If you need to talk to a school social worker, please call Darin Oliver at 698-9292.

Answer any questions. Ask if the participant would like to begin the interview. Thank the subject/participant and begin the interview.

- How old are you? What grade are you in?
- How many years have you been at Riverwest?
- Do you live close around here in the neighborhood? No need to tell me exactly, just want an idea of how close you feel to this community?
- Age, year in school, how many years in Riverwest?
• Are you involved in any extracurricular activities at Riverwest?

• Do you have any brothers and sisters?

• I heard you also have a job? I know this sounds like a stupid question, because I worked at BK when I was in high school for my own reasons. But, why do you have a job specifically?

• Do you take any other science courses?

• Overall, would you say you like science or not? How about environmental science? Could you tell me more about your mentoring relationship with Mr. J in the past and present? How do you like his teaching style, etc.?

• Any career goals currently?

• Now I’m going to ask you about specific things that I’ve observed in Mr. J’s class with you and feel welcome to response. If I’m too intrusive, please ask me to decline.

• Do you remember any of the particular issues that were discussed that stood out for you or that held your interest from PIP?

• A long time ago when your group was assigned overview questions for the Planet in the Peril film (show video as a reminder) 1sthrRESMenaPIPdis9-18PIPdiscussion

• You had to answer if environmentalists’ roles are successful.

• Transcribed excerpt:

  • MW: What number are we on?
  • Everyone: Number one.
  • MW: I wrote down the wrong thing for number one. So I do not really have anything.
  • Instructor (to the class): Let me share this with you guys again! I am not looking for an answer that you already have on your paper. Brand new, and you do not have any of
your personal answers on your paper. Collective what would you say now to those questions I assigned? You are going to share.

ARG: Oh! Right here. No wonder it was not over here. So we are still on number one?

Boy: Yeah. We are just sharing what we think.

MW: The fact that they studied them and take pictures. And I guess to just spread the word about their research. That is what I said for that one. And I think it has been successful.

Girl: Well I think it has been successful (08:08).

- Did you feel the instructions were clear? Are they usually always clear for you or not?

- How did you feel working in that group? Comfort level? Why? (found in 1sthourMW9-18smallgroupPIPdiscussion_02mp3xxxaudio at around 10:00) You mentioned you were too shy to present and you didn’t really talk much in that group – is this true of your other activities as well in this class (small group 10-22)? You eventually volunteered, however. in 1sthourMW9-18smallgroupPIPdiscussion_02mp3xxxaudio at around 10:00. You didn’t show up the next day but the following day your group presented. Play 9-23MWPIPPres1sthourPartII (video) to show physical characteristics / 9-23MWPIPPresentation1sthour beginning at 24:11 to show MW’s contribution.

- Question you had to answer: how do these issues relate to you? If at all?

- In the town hall simulation where you discussed your role as citizens of nature? (Play BE and MW on iPhone – 10-7 –beginning at 4:39) Also play citizens1sthourtownsimbw10-7 (1sthourRES) I noticed your behavior in this group was quite different here. Show position statement if needed.
• You have a good relationship with Brianna?

• Why did you have Brianna sum it up for you? You trust her judgment? Was she right about how your character would cause you to choose the friends of nature side? Show transcript for her to peruse

• How about after the town hall simulation. Was there anything that swayed your opinion that stood out? I also noticed that you went up at the very end and asked a question about security (begin at THS10-8 at around 45 minutes). Could you hear what you asked? Can you think of any your own experiences that relate to it?

• Relate this to a question (#13) on worksheet (#1) about growing populations (as would have occurred with the lumber mill). But still different. Can you give some examples of where this has occurred?

• Please tell me how you were feeling during a small group discussion about a particular question. What do you see here? Show maya1sthour10-22

• If you could think of an environmental science topic that could really hold your interest that hasn’t been covered yet, what would it be?

• From your own experiences as a young Black woman in relation to environmental science, do you feel as if the topics (either in class so far) relate to this part of who you are…Whatever that means?

Classroom/School dynamics

• Do you feel, overall, that your voice is heard in the classroom when you are discussing certain issues (both in small group and large group)? Would you prefer small or large group discussion?
• How do you feel about the make-up of the class in general compared to how you fit in? Do you feel any differences with certain make-up of groups?
Member-checking Interview – Passages from Amber

*Appreciation of the wonders of science/Nature of science*

It's interesting to me. I like knowing why this animal ... Animals, I like knowing why this animal did this, or why this animal looks like this, or ... I don't know. I like Zoo's too. I like looking at animals. Tiger's head are huge, really big. They're very ... Animal's are really cool to look at, because you ... Nobody really knows what's out there. You only know what people have discovered, but there's so much other stuff out there, that people have never seen. I think that's the mystery about Science.
Nature of Science

Amber: But Scientists don't have the opportunity to conduct everything they need. They don't get to say "Well, we got everything we needed today." They have problems too, all the time. It only fit, that we had problems. It only fit that we didn't all come back with all the facts we needed.

Phyllis: Do you think that's typical of Scientists in general, that they have to come together sometimes?

Amber: Yeah, even if they're not working on the same thing, they could correlate it in the same way, or change their experiment completely, like we did.
Engagement to topics-hands on/visual/relatable

Amber: I wasn't ... I haven't been ... I do the case studies, because I have to. I don't do them because I find them interesting.

Phyllis: Why aren't they interesting?

Amber: **I don't relate to that.** I feel like we should talk about stuff, because some people do like this stuff. This does grab them, the case studies that he's been doing, but I think that we should find case studies of our own, or choose from a lot of topics, because I know he has a lot of them. **I think we should choose from topics that interest us, because then we'll be more focused on it, rather than just doing it because it's work that we have to do. No, it didn't really ...**

Amber: Because you see it, rather than reading words. Reading words is you're reading it, the word. The. She. Did. It. **Video, you're seeing it. Your eye is seeing what it's doing, rather than reading a fact after fact, and reading somebody's quote about the fact. Yeah, maybe it's because I'm more of a ... I'm a visual learner, and I'm a hands on learner. I like engaging in the ... The trip, that was so fun to me.**

Phyllis: You really enjoyed that?

Amber: Yeah, I did.
Phyllis: That's cool.

Amber: Yeah, I would do ... If he presented the opportunity to go again, I would go again.
Relating race and gender to school

Phyllis: Do you think animals would be the only way to engage some of the young Black people that don't find the environment engaged?

Amber: I don't think it would be only African-American's that [inaudible 00:34:21] engaging either though, because Karen, and the other table behind us, they barely find the ... They do it, because like I said, they have to. I feel like school now is not directed towards a certain race, or certain gender. It's work, so you can graduate. It's busy work to do, so you can get out of school. It's nothing directly related to ... There's no groups for African-American's. I'm not ... I know I'm African-American, but I'm not one that's like I'm going to join this group, because I'm Black. I like people. I like everybody. If I like you, then I like you, not because you're African-American, because if I'm in the group, I'm probably not going to like half you all in the group anyway, because you all don't fit my personality. I'm not going to join together, just because we're Black. We know we Black. We don't got to be friends because we're Black. You understand what I'm saying?
Clarity of Teacher Instructions

Amber: Like I said, it wasn't specifically for AP Environmental. I would like it if we could ... I know you can't spoon feed me, but let me know a little more in depth what I'm supposed to be doing, so I can have a better understanding ... I talked to somebody who on a project that they're doing right now. They don't know what they're doing.
Coping strategies—Family/Spirituality/Religion

Phyllis: Is that where your spirituality comes in to ... I remember with the field trip too, you were talking about how you were reading scripture to prepare you ...

Amber: My Grandma did that.

Phyllis: Hmm?

Amber: My Grandma did that for me.

Phyllis: Oh, really?

Amber: I told her "Yeah, I'm going to a ..." I don't go to church every Sunday, but I know my parents ... My Mom and my Grandma are really church oriented. My Grandma especially, because she goes to church every time the door opens. That's where I ... I don't know scriptures. I don't know ... I do know who I talk to. I don't go to church every Sunday. I know who my Pastor is. My Pastor knows who I am. I'm still in touch with it, but I don't read my Bible. I don't have a Bible.
Member-checking Interview – Passages from Amy

*Strong racial identity (Caution with speaking out loud/Representative for race)*

Phyllis: What kind of things would you want here for Black folks?

Amy: Let's see. In Detroit, they have an African American museum. I go to that sometimes. They also have - They need more ethnic activities, just not for Black people but different folks because-

I'm not trying to be racist or anything. It's recording, right?

Amy: Kind of. I like learning about where I come from. I like learning the history of it.

Phyllis: Why?

Amy: I don't know. It's just something about how struggles can turn something into success. Going from slavery, although it was a bad thing, it also taught you to really push yourself because nothing is given to you. It's actually a person of race, not race, of color. You really have to work hard for what you want. By working hard, you're better than the average person.

Amy: I do because I'm proud of who I am. I feel like as Black people, they don't have representatives like me. They don't.
Phyllis: To just speak up for them.

Amy: Yeah, they really don't because-

Phyllis: What Black people do you think, in this school or just in general?

Amy: Probably just in general.

Phyllis: Really.

Amy: Just in general, yes. What I want to do- I'm proud of who I am and where I come from, and I like the fact- I don't like the fact, but I appreciate the fact of the oppression that we've been through and how it can shape lives throughout generations because of that. That will always be there. It's the fact that, with education, I just have to work a little bit harder just to understand a little bit more things. I feel like some things probably are a little bit more biased.

Amy: I can say it, yeah, I can say that. **Things are, even with history, things just has been just given to them, you can say. It helps them a little bit.** I just want to understand things more. I just try and push myself more so I can understand that. That's why I'm so hard on myself because I want- **Not saying I want to be on their level, but I just want to do good for myself. To actually understand things.**
That's why, when I was like I don't want to ask a stupid question. Not a stupid question, but have a stupid answer. I just want to have my answers prepared. I want to just be organized.
Understanding Teacher Instructions

Amy: I do because I know with every case study, it's going to- I know it's about a problem. That's what I know. **Basically now I know that he's asking me, how would you solve this? What ways would you solve this? Why would you solve it that way? Now I know his steps with the things.**

Phyllis: I see. Before you weren't necessarily- Were you clear on the direction?

Amy: Kind of but because it's an AP class, I take it a little more seriously than my regular classes. I just want to be well put together with my answers a little bit.
**Connection of case studies to personal (lived experiences)**

Phyllis: Do you think this does affect you as an individual, even something talking about tropical rain forest and destroying that and what it does to the environment? Can you relate that to yourself here in Kentwood or the community in any way? Have you thought of it or not?

Amy: Not really because I feel like with the rain forest, it's totally different from how I live my life. I don't live in a rain forest. I wouldn't go through any of the effects that animals are in a rain forest. Even with cutting down, I guess you could say with cutting down trees and building homes, spiders, they get into it because they live within the woods. They get into the house, and I hate that. I really do. I hate that so much. I do.

Phyllis: Yeah because there's other questions I need to ask you. Again, this Chinese takeout paper. You can look at it if- You laugh.

It seemed as if you were saying you claim that eating a whole bunch of animals could disrupt our whole ecosystem. Again, do you think that that's something that's important to you, to your family, or to the community, or it's just something that was assigned to you in class that-
Amy: Now, well, it's something that's assigned, but now that I think about it, it probably could. If I was really worried about it, it probably could have an effect on my because if I just eat random stuff, I don't know what the potential of it is harming me because I just eat it just to eat it. Just because I want to eat it. I don't know what it's going to do to my body or anything.

Say I ate all of the, what is it, it starts with a T. That fish.

Phyllis: Tilapia.

Amy: Yes. Let's say I ate up all of that. What would be left for whatever eats that tilapia? Then I ate that up. What would be left to eat that fish up? Then I ate that fish up. Who's left to eat that fish up? Then I ate that up. What would be left to eat that up?

*Environmental Science and Race*

Phyllis: I'm just wondering, do you think there is a topic that would interest, if not you, interest maybe the Black community? Yeah, I think that's enough. You or the Black community in general. However you want to interpret it. Or women?

Amy: I don't know because when I think of environmental science, I really don't think of- What I'm learning so far, I really don't
think of people. I think of animals. That's all I'm learning right now is just animals and how humans are destroying things. With the sharks, how we're killing more sharks than they're killing us. How we're tearing down habitats. Really not at the moment. Not anything that can be worth knowing for us to know at this moment.

Amy:

I think with the environment, with Black folks, we could probably learn to take care of ourselves within those natural situations. I feel like because maybe to me, maybe they just don't know how to be prepared for those situations even though it's everywhere. Have flashlights. Have water. Have canned foods. All that other stuff. They just don't know how to be prepared for it because nobody actually shows them.
Finding evidence to support claim

Amy: We'd do it again, so I can just not. Because we did just our evidence one time. We didn't do it a second time or a third time to actually make sure that it was right. **We just did it one time, and that really isn't support if you can say because it might be an error.** You don't know. That's something that I would do, I would do differently.

Amy: To me, that's- **I'm a person who just has to plan everything out to the way that I like it.** Just having one day, I just threw stuff together and copied and pasted, just put together what I thought went along with my claim. I didn't like that part. **When I read it out loud, I was mad because I did not like that at all.**

Phyllis: What you wrote here, you don't think it was, you supported it, your claim, very well?

Amy: I supported it, but it wasn't clear enough. When I was reading it, I was like, I don't understand this myself. How are they going to understand this?

Phyllis: Do you feel like learning in this class that you're able to verbalize your claims and then maybe learn how to give support to it?
I am. It's easy with different topics to give support because those topics are easy to find because everyone talks about them. With his topics, I wouldn't say they're not relevant, but they're not relevant. People don't talk about them. That's why it's hard to find stuff because people-
Member-checking Interview: Passages from April

*Incidence with race*

April: It’s better because…I don’t know, I got to know more people when…the last time that I came here, I didn’t really like it because um, it was more of a predominate race than it was my race. And so I felt as if, um….

Phyllis: So, what do you mean specifically? Was it more….?

April: Like…

Phyllis: White people?

April: Yeah, it was more White people.

Phyllis: Uh-uh.

April: Aaaaannd….with my grades and stuff I was able to take AP classes, AND I just felt as if, um, they thought I wasn’t smart enough to be IN there when I proved by my grades I was smart enough to be in there.

Phyllis: Mmmhhmmmm…

April: But, that’s (inaudible) matter. I dropped all of them and just stick to regular classes instead.
Restating parts of argument/Connecting to our own lives

Phyllis: Well, in 1 overall question. If environmentalists are successful. You said, I think they try and save the environment. Saving the environment is there. You said, “They’re willing to save the environment and species” And then you gave examples. “They tried to stop poaching and hunting of the sharks…and in another question, when asking about the responsibilities of individuals in managing natural resources, you said we need natural resources, so we should all be taking a part of that and then later on you mentioned about maybe in turns of producing the effects of global warming, burning less fossil fuels. And the way you said that, well I interpreted, well, it seems as if you were kind of firm about it. Like you were, it wasn’t like you were hesitant, you were just saying… was this because you had watched the movie or was it something that you had thought of before you took environmental science? I’m not sure.

April: Well, the fact that it’s been an issue with global warming and, ummm..the fossil fuels is the CAUSE of it. But, I thought we had to find some kind of alternative so that our planet don’t get destroyed. (sort of chuckles)

Phyllis: Mmmhhmm...

REASONING: April: And so with the fossil fuel thing, I did sort of feel firmly about it, because it’s our fault the reason why there’s global changes in the world.

Phyllis: Mmmhhmm...

April: So I think it’s our business to do something about it and reduce it.

Phyllis. Mmmhhmm...mmmm..let’s see. And you were also, you were saying how things happened around in the world, that it can affect other countries. Um, for instance,
you were saying, well because of the issue um of ice glaciers melting at a faster rate, how it can create flooding…do you remember saying that?

April: yeah.

Phyllis: And you were saying other countries…were you thinking about our country?

April: It could eventually affect us because we’re part of the ecosystem and all ecosystems are related and connected, like a food chain. And so whatever, if something goes wrong in part of the food chain then the whole chain is messed up.

Phyllis: Probably not. Mmmhhmm. Do you think …do you think about maybe, possibly having children or grandchildren, if that’s even something you want, um, do you think. Or, let’s say not even your children. Maybe, someone close to your kids. Does that make you think about it…do you think about that? Or do you not just yet?

April: What about if environmental changes is going to affect them?

Phyllis: Yeah. Like, global warming. The way the film brought it up and the way that you started figuring that out.

April: It probably could affect them later on since…a ways since that’ll happen.

Phyllis: Yeah, its aways away.

April: It’ll probably, if we continue to go the way that we are, it’ll probably be sooner than what we expect.

Phyllis: Mmmhhmm…But not necessarily a serious concern right now

April: Yeah.

Phyllis: Umm…and then with the, um, town hall simulation then. You were in the friends of nature. And I noticed that you were trying to rush to make sure you were in the friends of nature group.
April: Yeah.

Phyllis: Why?

April: Because, I don’t know, the environment is like everything. Because that’s…where we LIVE. And, like, the whole thing where they’re trying to move the park is unnecessary and I just thought…”they’re just messing with nature for no reason”. When it could have just stayed the same. Just adding more pollution and all this other stuff that we don’t need.
Different perspectives voiced in class

Phyllis: *Laughing with April*. Um, let me ask you a question and I don’t know if, let me skip to this part. Because I was listening to your small group discussion with Katie and the other students in the class where they didn’t have English as a second language. How did you feel, trying to discuss these viewpoints with people from different perspectives and different backgrounds. Do you think that was helpful to you or did you think that it hindered you in getting your points across? Or did you even think it was an issue at all?

April: I don’t think it was an issue. The fact that other people will have different opinions can maybe help me to think a little differently. Like it could change my perspective on things or add something that I didn’t learn or think. But then with the people from different backgrounds or there were…I just try and encourage them to like add something. What do you think? That’s what I wanted them to say? Because if it can make sense to me it can make sense to them too.
Theme of unity (transcends race) relating to environmental issues - Religion?

Phyllis. Hmm..OK. Um, Ok, so do you think that, um, this is a really direct question, because it involves my research, do you feel that the things that you’ve learned so far in Mr. J’s class has any sort of direct impact on you as an individual, on you as a young African-American woman, even in your community, whatever community that is…so, I can be talking about your physical community, like the neighborhood you live in, or like your family, or if you consider yourself religious, your church, or whatever other community that you’re part of.

April: Has environmental science had an effect on them?

Phyllis: Yeah, what you learned so far in class, has…do you feel that in ANY kind of way, that it relates to you as an African-American woman. Or do you feel that being a young African-American woman has nothing to do with any sort of impact that you may have had from the class? Does that have anything to do with how you feel.

April: No.

Phyllis: It’s just…so then, does it impact you more as just a general citizen of the community or do you even feel that there is a significant impact on you specifically.

April. No.

Phyllis: No? Why not?

April: Because, well, here with the environmental things that we had. I just think that it doesn’t affect me, just ME, I just think that it affects everybody because we are all a part of the same world.
Member-checking Interview: Passages from Bailey

*Theme of caring for environment/environmental school/daughter of environmentally conscious mom*

Phyllis: And so you watched that for awhile. Uh, so I made some observations over discussions that you had at your table, which were really entertaining to me. Because they were, I mean you guys were really discussing it. It was just really entertaining. And, uh, one of the things that you brought up that I transcribed was, there was a question about do you think that, uh, environmentalists are successful? And you, do you remember what you said?

You said, uh, not really, because there weren't enough environmentalists that cared-

Bailey: Oh. Yeah.

Phyllis: Like, you brought that up several times.

Bailey: Mm-hmm (affirmative).

Phyllis: Uh, what made you say that? Were you relying on the film? Were you relying on anything else? You tell me, like-

Bailey: Uh, well, like, I went to environmental school in middle school and elementary. And, like, we just would talk about stuff like that. And I just feel like there's not enough people that care about the
environment or actually think about being an environmentalist and stuff like that.

Phyllis: Mm-hmm (affirmative). So you say you liked, uh, environmental school. Didn't you-

Bailey: Yeah.

Phyllis: Didn't you say you liked it?

Bailey: Mm-hmm (affirmative).

Phyllis: So that was one of the main things that came out that you learned from there?

Bailey: Yeah.

Phyllis: Is that, about caring?

Bailey: Yeah.

Phyllis: Was there anything, do you remember anything about school, about environmentalist school that made you think, like, man, people need to care more?

Bailey: Yeah. And we would walk the trails up there and just, like, see the erosion and all the stuff that people do to the environment out there. And, uh, our teacher would just talk about how people are just careless about things and how it's not enough people that actually go out and actually try to explore the environment instead of trying to destroy the habitats and stuff like that. So ...
Connection of (environmental) science to career goals

Phyllis: Do you feel like you could benefit from this course?

Bailey: Uh-

Phyllis: What do you think? Or is it not what you expected?

Bailey: Well, I don't know. It's like giving me ideas for what I want to go to school for. So, like-

Phyllis: Really?

Bailey: Yeah.

Phyllis: Like what?

Bailey: Uh, I'm not, like, that's what I'm not sure of. But I like science-

Phyllis: Mm-hmm (affirmative).

Bailey: So, I was trying to take all the science classes I can. Like, on my transcript it's a lot of, I took a lot of science classes-
Evaluating arguments

Bailey: OK. And then, what they said, how they, how the, uh, people that wanted to keep it didn't have a plan for (laughs)-

Phyllis: (laughs)

Bailey: Didn't have a plan for how they were going to get the money to-

Phyllis: Mm-hmm (affirmative).

Bailey: Do all that, in taxes, and all that stuff like that. And I was just, like, they have a good point. And some people actually don't even care, really.

Phyllis: Mm-hmm (affirmative).

Bailey: So just, like, yeah, the raise of taxes for no reason. It just, uh, just changed my mind.
Because a lot of schools are, like, a lot of students at the public schools are, African-Americans go to school there. Mainly African-Americans, so, but this area there's not a lot of them, so.

Mm-hmm (affirmative). Do you get, so then you get that in Riverwest that, uh, there's an understanding that African-Americans kind of, sort of, we have each other's back-

Yeah.

Kind of like that kind of thing?

Mm-hmm (affirmative).

Do you feel ... I can kind of guess what the answer is, but I don't want to make an assumption ... do you feel like you're an active participant ... and, I know, it's just a bird, I don't know. I was trying to get, like, a classroom, but whatever. Uh, do you feel like you're active? That your opinions are being heard in this class? At your table, or just in general, even when you were changing groups?

Well, no. I just ... I don't, I don't know. Uh, I just have certain people that I like to talk to. Like, I get along better with African-Americans. So it was just, it's easier to talk to them.
Phyllis: That's cool. Uh, let's see ... Is there anything else you want to add in terms of just, uh, how you feel in terms of the dynamics in the classroom? Whether it be environmental science class, uh, and, well, let's talk about environmental science class and the dynamics there. Is, so you're saying, like, because you're able to sit with, mostly, like, Abraham, and Frasier, and join all of them, do you think that that helps you as a Bailey? Or do you think if you had to move to different, uh-

Bailey: I wouldn't feel comfortable.

Phyllis: With other White people? Or is it just White people, or anybody outside of being African-American?

Bailey: Uh, I just think it's easier to get along with your own race.
Member-checking Interview: Passages from Brandy

Connection of human lives to environment

Brandy: So, I was trying to go to that one but I ended up in environmental science. Um, it’s, it’s OK. You just learn about more stuff like, like when we did the Planet in Peril thing. That was really interesting to me. Because you don’t know about that stuff on a day-to-day basis. It doesn’t just….your teachers don’t just tell you about all that stuff.

Phyllis: Mmmhhmmm…Yeah, I noticed that you seemed to be really interested when you were watching the film…

Brandy: Yeah.

Phyllis: I wondered what you were thinking about. About that.

Brandy: It was just really interesting to see different things and how, the things we do on a daily basis affects the world, not just us, it affects everything.
**Diversity of school aids in students getting along**

Phyllis: Do you feel. You’re a senior and you’re aware of your identity as a young African-American woman. With all these other issues in your life, do you feel like your role here, maybe different than someone else than say a White boy, or something like that. Or, am I being too general? Can you honestly say that or? It’s a diverse school.

Brandy: **Yeah, we all get along here. It’s not just the Blacks, the Asians, and, like…no. everybody’s diverse.** Like, **um, we all get along well.** There’s not really much fights here. Or drama or anything. It’s very, I’ve been here for four years and I can say I’ve seen maybe TWO fights.

Phyllis: Yeah, I’ve noticed that.

Brandy: Everybody gets along here. It’s really nice. And the kids there, they don’t like dumb you down. Like if, if you’re failing a class or something, there’s a group of seniors that actually teach OTHER kids, the lower classmen, it’s really, really nice here.

Phyllis: That’s great. So. Going along with that, since we’re talking about environmental science, do you feel like you are an active participant in the class. So what I mean is, you’re active. Do you feel as if your voice is heard no matter what group you’re in because I noticed that sometimes he puts you in different groups. Um, but do you feel comfortable being in these groups with different people…

Brandy: Yeah.

Phyllis…and….

Brandy: **Yeah, because I feel that they don’t judge you on your skin color like they’d do in different schools. They don’t. they just look at you like you’re just another person in here. They don’t really judge you at all.**
Brandy: Not really, no. That’s why I think so many people come here. It’s not just like an all White school or an all-Black school. You have people that are from EVERYWHERE here. And we get foreign exchange students. I think this year we got maybe like 12 and we sent 12 to like, China, I think it was. So they do that too and that’s cool.

Phyllis: So would you say get a lot of various perspectives?

Brandy: Yeah, Mmmhmmm.

Phyllis: And in your discussions in class, in environmental science class that leads to the perspectives?

Brandy: Yeah, ‘cause different people have different beliefs here, yeah.

**Connecting personal experience to town hall simulation (argument)**

Phyllis: So, after the town hall simulation, how did you…were you able to confirm any of the issues that you had with it?

Brandy: When we were doing that, I don’t think they were really trying to touch base on my questions, but they were just like more focused on bringing in MONEY and they didn’t seem to care really about the people that were in that neighborhood. They didn’t care. They just wanted MONEY, MONEY, they were money-hungry. But, um, they didn’t really touch base on how the people would be affected or anything like that.

So,

Phyllis: so, how did that make you---did you relate any of THAT to your own experiences. You focus on the fact that they were all about the money instead of focusing about the on people. Do you want to elaborate more on that or can you?
Brandy: No, I just feel like they should have looked at more of the people’s shoes that live in that neighborhood. They’re so use to peace and quiet and now you’re just bringing in all this CHAOS. Like, that’s just going to affect them greatly. **Um, I can kind of relate to that, because where I live, it’s kind of like peace and quiet but now they just built this huge Family Dollar over there, so now it’s like a lot of traffic and it’s just crazy. I don’t understand why they ever did that. ‘Cause it’s just too much traffic. And it’s like, a lot of kids in that area ‘cause it’s an elementary school over there? And with all that traffic, like, kids are getting hit by cars and some kids…kids are getting kidnapped easier now and they’re just trying to walk to the store.**
**Family responsibilities and academic challenges**

Phyllis: How many hours would you say you work a week?

Brandy: A week, in school, I only get to work up to 24 hours.

Phyllis: Oh, ok

Brandy: So, 24 hours.

Phyllis: Wow…so you get the maximum.

Brandy: Yeah, the maximum.

Phyllis: How long have you had the job?

Brandy: Um, almost a year.

Phyllis: How does that, um, affecting your school work?

Brandy: Um, I took pretty easy classes, though not much, sometimes when I work too late, I go to school instead of doing my homework. *Sometimes, yeah. Sometime, I don’t’ get enough sleep. Like, I have insomnia and um, sleep apnea. So, I have a hard time staying asleep. I stop breathing when I sleep, that’s my sleep apnea. So, I wake up…*

Phyllis: And I did notice, a pattern of, sometimes in first hour, you came in late? Is it because that sleep apnea and insomnia and all that?

Brandy: *Yeah, it’s hard for me to get to sleep and when I do get to sleep, it’s hard to wake up.* And then I have to take my sister to school in the morning, and THEN come here. And I live all the way downtown, so yeah.

Brandy: Well, my nephew is a lot easier. I wouldn’t say I raised them, but my sister got pregnant at sixteen, *so I’ve always been there to take care of her kids while*
She worked two jobs, so it’s…I kind of feel like they’re MINE because I have them 24/7. So, yeah, my nephew is a lot easier. My niece is a handful. She’s a handful.
Benefits of Riverwest over urban school from neighborhood

Brandy: So around there, the schools are just like, kids are just there because they have to be there, there not like really learning, like there only a handful of kids graduated and my mom just didn’t want me to go there.

Phyllis: Only a handful?

Brandy: Yeah. It was like 50-75 kids graduated.

Phyllis: Oh my goodness. Like, about, of about how many? You think? (inaudible at 1:13)

Brandy: Yeah, last year we had 570 graduate from here.

Brandy: I like it like that because if I would have went to Unicorn, I feel like I would have just been like everybody else. Well, I’m not a slacker, I like to have straight As and Bs. I was a 4.0 student my whoole life…

Phyllis: Mmmhhmmm.

Brandy: And I came here and, like, Rockyville Schools it was like cutting CAKE. And then when I got here, it was just completely DIFFERENT. Like, here, they actually teach you. I feel like, in Rockyville, you just go to school. You think you’re learning, but you’re just going to school, really. So, here, it’s a little more tougher and challenge me more but I like it better.
Connection to (environmental) science and career goals

Brandy: Yeah, I really like the anatomy. I, I wouldn’t say that I really like science. But, when I took anatomy, I really liked it.

Phyllis: Really?

Brandy: And so, it’s just like, my teacher, I don’t know if you know Miss Fall?

Phyllis: I probably met her, but…

Brandy: She just told me that I should take AP BIO because it’s just like anatomy. It’s not just like anatomy.

Brandy: I’ll just take it now because I know I’m going to have to take it again in college. So…

Phyllis: Mmmhhmmm.

Brandy: It’ll be like a refresher.

Phyllis: Mmmhmmm…So what do you want, um, to do? So, have you thought about career goals…

Brandy: Yeah, I want to start off with a medical assistant and then just go higher.

Higher and higher.

Phyllis: Mmmhmmm…what’s higher and higher mean to you?

Brandy: Um, go up to LPN and then, I don’t know where I want to go from there yet.

Phyllis: And it seemed like, I also noticed that you liked the zoonotic viruses, like when they were talking about that. Or at least discussing it with Mr. J.

Brandy: Yeah, I was discussing it.

Phyllis: Mmmhhmmm.
Phyllis: Anything that stood out for you with that?

Brandy: Not really.

Phyllis: Just, very interesting…just another interesting topic.

Brandy: Yeah, just to see how you can, um, just get it from animals. That was interesting. Just, not people, people contact. Just, you can actually get them from animals. But, yeah.

Phyllis: Um, does that change, the way that you look at your career goals, like, thinking about illnesses, and things like that, did it…?

**Brandy:** I definitely feel that after watching those videos, it makes me wanna go into the medical field MORE.

---

Brandy: **It just made me want to go to the medical field more.**

Phyllis: Really?

Brandy: Yeah. I don’t know, it just, certain stuff just catch my attention. Like, there’s ways that you can help people. You don’t just have to sit back and watch people die. You can actually help people in different ways. So yeah, it just made me want to be in the medical field more.
**Connection to environmental topics and personal life**

Phyllis: OK. Let’s go to environmental science. Do you feel like, so far, that um, there were any topics that seemed especially relevant to your own personal life right now or to your family that made you consider them, besides the diseases and viruses that we just talked about?

Brandy: **No, not really. That’s just what really stood out for me. ‘Cause all those volcanoes and stuff like that, we don’t live near any of that to have any---so yeah, nothing else really.**

Phyllis: If you had to pick a topic in environmental science or additional information on something that you think would help you in your life or at least be more informative. Could you think of something?

Brandy: Not off the top of my head, I couldn’t think of anything.
Member-checking Interview – Passages from Darlene

Benefits of attending Riverwest over urban school – Academically challenging

Darlene: No, in Westminster, I was doing well in school and then when she transferred me to a public school, [it flicked 00:05:23], it went all downhill because I got bored because I had already learned all this stuff beforehand.

Phyllis: Oh, I see, so it seems like you were saying they were behind you, yeah.

Darlene: They were two years behind us, so I was like, "I already learned this, so I don't need to learn it again" and I was [cutting up 00:05:41] at school because I had nothing to do because I was already finished my work a half an hour early.
Benefits of Riverwest/Reconciling individual challenges with school/Coping strategies

Phyllis: Okay, so you have been taking tests outside of the class and that has helped you?

Darlene: Yeah, it has helped me a lot because I have more time, because when I am in the classroom, I feel pressure, like, "Okay, I've got to go fast. This person is just finishing and I don't want to be the last one but I don't want to be the first one" and [crosstalk 00:08:00].

Phyllis: They have been really good about that?

Phyllis: Are you keeping caught up, are you able to do that?

Darlene: Yeah.

Phyllis: Really? Is there, do you need assistance with keeping up with that work because ...?

Darlene: If I'm missing something, I think he will tell me if I am missing something and I will do it the next day.

Phyllis: Oh okay, so you would say he is good with doing that kind of stuff?

Darlene: Yeah.

Phyllis: Does that, have you ever thought about how that affects how you are in school? Do you have to leave class to do that?
Darlene: I never leave class to do that.

Phyllis: Oh really?

Darlene: I always do it in between class. I have taught myself not to leave class to do it. That's why I have hand sanitizer and it's so low right now, so I have to go and get some more.
Aversion to science

Darlene: Yeah, I took chemistry and I took biology and that was about it.

Phyllis: Are those requirements where you had to take them?

Darlene: Yeah.

Phyllis: Is it, do you like science?

Darlene: No, not at all.

Phyllis: No, not at all? What don't you like about it?

Darlene: I don't like the whole, I don't like chemistry because of all the tables and stuff like that. I don't understand it. It's weird actually.

Phyllis: Really? What about biology? Is it weird too?

Darlene: Yeah, it's gross.
Classroom Dynamics/Lack/More of group affinity

Phyllis: Okay. But first off, well, let's go into how was it working with them?

Darlene: They didn't want to do the work.

Phyllis: What do you mean by that?

Darlene: The guys, they were just like, "Oh, I'm not going to read, oh, I'm not going to contribute." I'm like, "Well, you have to, so get it together because I'm not going to fail because of you."

Phyllis: How did you, so it was just the guys that were acting like they didn't want to work?

Darlene: Yeah, yeah.

Phyllis: Were you, what was going on there?

Darlene: I was looking at notes and trying to get the questions now, but I can figure out this one question, like, "Guys, just help, just get this over with and just help."

Darlene: You know that guy with the red thing, [he is over there 00:22:29]. I wanted to just hit him with that board.

Phyllis: This one?
Darlene: Yeah, I wanted to hit him with that board so bad, [he just wouldn't work 00:22:35] ...

Phyllis: Was he just, he was just trying to talk about other things, from what I heard?

Darlene: Yeah.

Phyllis: Are you used to these kinds of experiences, and these kind of classes dealing with some gentlemen or some women that just don't want to do the work?

Darlene: Yeah.

Phyllis: Would you describe yourself as someone who likes to get the task done, is that what you are saying?

Darlene: Yeah, I want to get it done, and the sooner we get it done, you can do whatever, I don't care what you do, I just want to get this done.

Phyllis: That's really good if you need to do that. Okay, let's move down to the town hall simulation. Did you like that or did you not?

Darlene: I liked it because I had a better group and we were each willing to contribute.
Darlene: It did, and we all just went with the majority rules and then we just [wrote that 00:34:42].

Phyllis: Really?

Darlene: Yeah, and they were done in two seconds.

Phyllis: Did it at all seem interesting?

Darlene: No, because we had pretty much did it in two minutes. We were like, "Who all agrees?" Everybody raised their hand and it was like, "Okay, why do we agree?" Then we just, somebody just shouted out the answer and it was like, "Okay, we're done."
Discursive challenges – wording/teacher instructions

Darlene: Yeah, he explained it and I was like, “Oh, okay” and then I just answered the question.

Phyllis: It made sense after he explained it?

Darlene: Yeah.

Phyllis: Do you remember what he said?

Darlene: No.

Phyllis: But it made sense at the time, and so you were able to go forth and do it?

Darlene: Yeah, but I'm like, he should just reword his questions better.

Phyllis: Do you have issues with that in that class in terms of the scientific language that [you were 00:25:37] wondering?

Darlene: Sometimes. Just earlier, I had to ask him a question about the case study because I didn't understand it.
Evaluating Argument

Phyllis: With that, when you were meeting before to create the position statement, you brought up several things and I was having some difficulty hearing you, but you were saying, and I highlighted it so, because you were all just trying to figure out, "Right, what are we supposed to be doing as county commissioners?" But you were making some interesting suggestions, like you said, or you were making comments like, they are only listing things such as cost and benefits. I heard that part, do you remember that?

Darlene: Yeah.

Phyllis: What did you mean by that?

Darlene: Because we didn't know where the money was going to be coming from, but they were only telling us, "Okay, this is going to happen" and "This is going to happen." I'm like, "Well, how are you going to make this happen?" They [weren't 00:28:09] answering your questions, so I was like, "We should have put that in there" because I know they are not going to answer it.

Phyllis: Can you give me examples of maybe any, a question, a specific example about cost and benefits that you would have asked them?

Darlene: What are the benefits of this project going to be, and how much is this going to cost people in general, [people that live around and animals
00:28:37], but is this going to, around the area, what is this going to do to the animals that are there, before you would get a benefit out of it?

Phyllis: Really? Okay. Cool. Let's see. Let's see, what else do I have down here. You made good suggestions that we should write down a list of questions for your group, and you said something like, "Say, if you have a little budget, how would you build it?" You are coming up with different kinds of questions like this. Does this, does any of this, and another comment where you are like, "I mean, because they are chopping down a lot of trees, chopping down all these trees." I can make out some of the stuff that you were saying.

Darlene: Yeah, because they were all chopping down a whole bunch of trees, and I'm like, "Okay, are you going to rebuild these? Are you going to replant these because those are a lot of trees?"
Connection of class environmental topics with personal life

Darlene: Yeah, because they were all chopping down a whole bunch of trees, and I'm like, "Okay, are you going to rebuild these? Are you going to replant these because those are a lot of trees?"

Phyllis: Have you, can you think of something in your personal life, does this remind you of anything that has happened in your life, in your family or in your town or in your, anywhere where you had to debate something that dealt with the tearing down of something or the building up of something?

Darlene: No.

Phyllis: Nothing, okay, so anything in environmental science class, do you feel like it impacts you as a person?

Darlene: Yeah.

Phyllis: Or relates to you or has some kind of weight on you?

Darlene: Yeah. I can give you an example. Okay, I was [in New York with my boyfriend at the gas station in the car 00:35:49] and we had a whole bunch of water bottles in the car because [everybody had a water-box and they 00:35:54] would drink water a lot. I was like, "Are you done with this?" He was like, "Yeah" so I threw it outside and he got so mad at me for throwing it outside. He was like, "Why did you do that?" and "This is going to effect the environment." I'm like, "You
sound like Mr. J right now." He goes like, "Because it's true." Then he got outside the car, went to go for the bottle and threw it in the trash.

Phyllis: Do you think there are issues about the environment living in the, would you say we live in the city or not?

Darlene: In it? Yeah.

Phyllis: Would you say that there are maybe issues in our city?

Darlene: Yeah. Now I realize like after that whole situation, I would look on the ground and there is so much litter everywhere, and I really didn't notice it before until they pointed it out obviously.
Race/gender and academics – no real connection

Phyllis: Good, because I didn’t want mine to keep beeping and distracting you.

Okay. Now, I'm just curious because I'm looking at African-American girls, do you feel that in this school that any of your identity being a Black, young Black woman, does it affect you in any kind of way in this school? I understand, looking in the hallways is really diverse and which, I think it's cool looking, but have you felt academically or however you want to answer it, personally do you feel like your identity impacts or plays any kind of role in this school?

Darlene: No.

Phyllis: Really?

Darlene: Yeah.

Phyllis: What's the, so that's a good thing then, right?

Darlene: Yeah.

Phyllis: Why is that a good thing for you, especially if you compare it to maybe Grand Rapids Public?

Darlene: I mean, because everybody is different and I know that everybody learns different so my skin doesn't really affect my brain, I guess.
Member-checking Interview – Passages from Janice

Engagement of topic- hands on learning/teaching issues

Janice: It’s like, I don’t…it’s like, I use to be interested when it seemed like something new but it seemed like old and boring.

Phyllis: What do you think makes it old and boring now?

Janice: Like, in 9th grade, there were like hands on projects and stuff. But we don’t really do that. I don’t really like it.

Phyllis: Wow. That’s a big school. Totally different than the school that I grew up in. We were stuck with one of each. Um, how do you like Mr. J.’s teaching style in environmental science?

Janice: He really don’t teach, really? He don’t really talk about (inaudible at 9:25). We usually just get papers and do them. And then we write movies and stuff. It’s not really often that he stands up in front of everybody and TEACH. It’s alright.

Phyllis: Well, I’ve made observations in class and it seems as if, well, I don’t want to make assumptions. But if he doesn’t teach, does it mean that you’re not engaged?

Phyllis: What would, in environmental science class, and I know that this is kind of deep question. What do you think would interest YOU…I know you mentioned the hands on learning really engages you. Let’s say we had to change this to a topic, like something that he goes over. Do you, have you ever thought of any topics that you would be interested in for you to talk about that would maybe engage you?

Janice: Well, we talked about pollution, but I want to talk about more in it. Because he said we’re going to talk about different places, and stuff like that. And we haven’t really done that yet.
Phyllis: Oh. So maybe he will later on and *(inaudible)*. Why are you interested in pollution?

Janice: Well, I’m not interested in it. But it’s just like, he said the different places that *(inaudible at 11:17)* different stuff, like, you’re not going to... he said, like, where do most people want to live when you get older? He said, you’re not going to want to live there for some reason. But he didn’t go into details and *(inaudible at 11:30)* learn about different states *(inaudible at 11:37)*

Phyllis: Is there anything else you wanted to contribute just based off of environmental science class and the short time that you’ve been here, is there anything any comments that you make about the class, anything at all? That would let me understand you a little bit more and um, I just wanted to know if there’s anything else you’d like to contribute about eh class?

Janice: Not really. **I think if Mr. J. was more involved with the class I would be more interested in it.**

Phyllis: The AP class seems to do things differently than the regular class. Like, they do things like um, case studies, where they have discuss stuff and they had to present and then they had a field trip where they had to design their own study. Does that seem more appealing than what has gone on in this class.

Janice: **Yeah. I think if it was more hands-on, then I would probably want to learn about it more, but I’m just trying to get done.**

Phyllis: I hear you. I think that’s all I have for you.
Values diversity/race and gender unimportant

Phyllis: I noticed that and that worked pretty well with you? Do you feel as if, I know you’ve been in Riverwest since like 4th grade…has it always been elementary, everything, has it always been diverse like this?

Janice: Yeah.

Phyllis: Really? You’re use to that.

Janice: Yeah, I’m use to it.

Phyllis: How do you like it?

Janice: It’s alright. I think it’s (inaudible at 20:47). I don’t want to be with the same people.

Phyllis: Oh, really? OK. Let’s see. Do you feel like your race, gender, or anything play any role in any way at this school? And you can interpret it in however way you want. I know it sounds vague but there’s no right or wrong answer. But do you think about class, race, gender…in environmental science class in this school, do they play a role in when you’re learning. Do you feel that way?

Janice: No, not really. I don’t think about it for real.

Phyllis: Do you think…does that have to do with how you were raised or being in this school system for a long time…

Janice: Being in this school system for a long time because, it’s been a lot, there’s a lot of different races and stuff like that so I don’t think that it’s something that people really think about…well I don’t. I don’t think it’s like a big deal.

Phyllis: So you don’t feel that like race or gender or anything like that will stop you from completing your goals or anything?
Janice. Yeah. I don’t think that.
**Group cohesiveness – internal friends**

Phyllis: Do you remember how much you played or anyone played a role in contributing to group? Was it hard to come up with?

Janice: Not really, ‘cause we all contributed to the whole thing. So, we all like really came up with the answers.

**Phyllis: So, you don’t remember any disagreements, it was pretty smooooth?**

**Janice. Yeah.**

Phyllis: Ok, this is when you were working in that group for *Planet in Peril* (names the names of students in the group). How did you like working in that group?

Janice: **It was alright. I know them already, so.**

Phyllis: Oh, really, how long have you known them?

Janice: I’ve know Billy since *(inaudible at 15:47)*

Phyllis: Because it sounded with the conversations that you were pretty comfortable with them?

Janice: Yeah.
Individual academic challenges – use of after-school program/mentoring

Phyllis: Has it helped you?

Janice: Yeah. I used to slack with homework but ever since I been at WIA, I’ve been doing my homework.

Phyllis: Oh. Is that what the group is about? You do your homework there and you take your time?

Janice: Yeah.

Phyllis: With teachers helping?

Janice: Yeah.

Janice: I’m doing good. Well, now I’m doing good. Like, I turned in all my work but the test was getting me mixed up.

Phyllis: Oh.

Janice: Now, he helping me study for the test. And I’m getting better grades.

Phyllis: Oh, in the WIA group, he’s helping you?

Janice: Yeah.

No connection of environmental topics to personal life

Phyllis: Oh. So maybe he will later on and (inaudible). Why are you interested in pollution?

Janice: Well, I’m not interested in it. But it’s just like, he said the different places that (inaudible at 11:17) different stuff, like, you’re not going to…he said, like, where do most people want to live when you get older? He said, you’re not going to want to live there for some reason. But he didn’t go into details and (inaudible at 11:30) learn about different states (inaudible at 11:37)
Phyllis: Can you relate these issues to living around here?

Janice: Not really. I don’t really think it’s a big idea in my everyday life. I don’t think about pollution or stuff like that.

Phyllis: Could you relate something like that, the point of building a business, has anything like that happened in Riverwest, and I mean I know Mr. J. mentioned that incident complex outside the class that were woods. But do you think of anything in your own neighborhood where there was a build-up of a business and something wasn’t affected because of it?

Janice: No not really.

Phyllis: Really?

Janice: I can’t think of anything.
Member-checking Interview: Passages from Maya

Appreciating the diversity of schools

Maya: You get a glimpse and feeling of everybody. You're not just used to the same thing. It's different. Yeah, and you get to meet new people and stuff.
Individual challenges (wanting to overcome through extracurricular activities)

Phyllis: So like it then or not?

Maya: I do it, but then again, I don't. I'm just shy so I was hoping that hopefully I'd break up my shyness. I've been getting a lot better. I still get nervous when people like do sing and stuff, but I'm okay. I just wish I had maybe like an R&B choir or a song choir. I think that …

Phyllis: Okay. One of the things you said, I noticed … Do you remember how you were feeling? You said that you're shy.

Maya: Mm-hmm (affirmative).

Phyllis: Do you remember feeling shy during this discussion with this group?

Maya: Yeah, because I don't really know them, so yeah. I'm really shy. [Inaudible 00:16:19] top most.
Mentoring through Mr. J.

Because I'm in it, Mr. J in class, he'll … I don't know. He helps me a whole lot, so that means getting behind in my work and he'll just say, “Just get it turned in.” I guess thereafter he can help me. This is the class I'm struggling in.

Phyllis: Oh really? This is the one class out of all the classes you take?

Maya: Mm-hmm (affirmative), I'm struggling in. I've never been really good in science or like chemistry but Mr. J, yeah, he's not going to let me [into 00:06:48] behind, no. That's why I like having him.
Connection of environmental topics in class to school/family

In any way you want to … however you want to interpret what I ask. Do you think, watching that film, do you feel far away from those issues or do you feel a little bit closer? Could you make … Do you think it's important for us here in this city?

Maya: Yeah, it is important.

Phyllis: Why do you think it is important?

Maya: It tells what happens in the environment and it will affect us anyways no matter how far away it is.

Phyllis: Really?

Maya: You said does it affect my family?

Phyllis: Do you think it affects any of those issues?

Maya: Yeah.

Phyllis: Really? Why?

Maya: Because it's like … For example the zoonotic virus, what if you come in contact with someone who has that and can infect us. The shark-finning, my grandma had statues and stuff and I never knew that
those statues were made out of the shark … Wait, the shark-finning, wait. No, wait. I think I said [inaudible 00:33:30].

Phyllis: Oh, there was the ivory tusks too.

Maya: Yeah, that.

Phyllis: Okay. Was that what you were referring to?

Maya: Yeah. Made out of ivory and whatever. Yeah. It's more like the zoonotic, yeah, that could affect us.

Phyllis: With the ivory thing, when you found out your grandma had something that was made of it, what did that make you feel?

Maya: Because I didn't know until I saw that video, then I ended up remembering that my grandma had a whole bunch of statues and it was … I don't know, it kind of I guess to me seemed cool, the curves. That and making too statues and stuff, but yeah. I don't know if that answered your question.

Phyllis: Okay. Can you relate … I don't know if you can. I don't know, whatever, but can you relate to this town-hall simulation and relate it to something that ever happened in your community ever or anything about it? Did it remind you of anything that happened to you or not?

Maya: No, not really.
Phyllis: Really?

Maya: Not really. No.
**Group affinity – friendship aids in feeling comfortable in groups**

Phyllis: Okay, but did you feel differently in this group compared to this other group that you were in for the [planning in payroll 00:39:49]?

Maya: Yeah, I did.

Phyllis: Your comfort level?

Maya: Yeah.

Phyllis: It helped with Brandy being there or no?

Maya: Yeah. With the first group, Vanity is in that group but I don't know [inaudible 00:39:59] but Vanity isn't really talkative and so when I was in the group with Brandy, Brandy talks and I don't know, I just … Yeah, me and Brandy have a better relationship than me and Vanity and so I felt comfortable.
Class dynamics – small group preference

Phyllis: Do you feel overall ...? Would you prefer small or large group when you are discussing things?

Maya: Small.

Phyllis: Small, for the reasons we discussed earlier, or anything else?

Maya: I don’t know. Sometimes everyone does get the chance to say something.
Evaluating arguments

Phyllis: Did the town-hall simulation with everyone coming up and bringing up some points, did that help you at all with the decision?

Maya: It did. Yeah.

Phyllis: How did it help you?

Maya: Because it helped me understand what everybody else was … How everybody else thought about it and what everybody else, what they thought was positive and stuff about it and the outcome.

Phyllis: Did it change anything specifically that you could think about, that you could remember from that time? Did it make some things more clear or more confusing?

Maya: When you say that, they had like … Didn't somebody say that they were building … it'll be like a lake and there'll be like ducks or something like that?

Phyllis: Mm-hmm (affirmative).

Maya: So yeah. That, and then I was like, “Oh, okay. At least ducks have somewhere to go and stuff.”
Engagement of environmental topics – connection to celebrity

Phyllis: Oh, I understand. Okay, and I don't have to [relay 00:48:04] like say, “Come on! Remember!” Anyway, if you can think of an environmental science topic that hasn't been covered yet by Mr. J; anything, whatever, that you think would be interesting to you, can you think of any that you would want to learn in this class?

Maya: I would like to know about … I don't know if it … Maybe Honduras.

Phyllis: Really?

Maya: I saw … plus a role model of mine is Left Eye from TLC and she's been my role model since I was eight and she passed away when I was …

Phyllis: Aw! I know.

Maya: Yeah. She's always been like a big role model of mine.

Phyllis: Why? Do you know why?

Maya: Because she's just always some … She's always been something I've always wanted to be. She was very just full of energy and she wasn't really much of shy for instance and she'll say whatever she needs to say. She was big on nature too. J-lo has been a big role model of mine. She used to go to Honduras there to find like spirits and things and stuff and she said …
I saw on her documentary, it was a deleted scene, and she was saying that there was water … Some of their water there is like [inaudible 00:49:47] like pH or something and it really cleanses your … It's really good to clean in. It said that water was full of like minerals or something and I've always wanted to know if that's everywhere in Honduras or was that just a specific place she was at.
Maya: Let’s say [I’ll give it to you 00:00:07] all the way back from slavery and stuff when we didn’t even know how to read and write so learning how to ... finally learned how to read and write and learning about science, it’s just really ... I don’t know. Everything’s like...people were, like, just strong people and knowing that...you know, on top of that so like learning about science and then becoming doctors, it’s pretty cool.

Phyllis: You’re thinking about going all the way back to slavery times and then where we are now?

Maya: Mm-hmm (affirmative.)

Phyllis: You think that’s pretty awesome.

Maya: Yeah.

Phyllis: Mae Jemison, are you saying that’s an example of an awesome ...?

Maya: Yeah, and her being the first Black woman to go out in space and [inaudible 00:01:13] worked to get to that part [inaudible 00:01:19] ...
Appendix C

Discourse Analysis Templates and Maps
### General discourse analysis template using uptake across the interaction units

<table>
<thead>
<tr>
<th>Line</th>
<th>Message Unit</th>
<th>CC</th>
<th>Con fxn</th>
<th>Loc of Know.</th>
<th>Con fxn</th>
<th>Loc of Know.</th>
<th>Argument</th>
<th>IU</th>
<th>SI</th>
<th>Non-verbal</th>
<th>Identities</th>
<th>Linguistic evidence.</th>
<th>Uptake across IU</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.* CC = contextualization cues, fxn = function, Loc. of Know = location of knowledge, IU = Interactional Units
<table>
<thead>
<tr>
<th>Message Unit</th>
<th>Lived Experience within the Narrative</th>
<th>Social Identity Within the Story Telling Event</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Social Map of Lived Experience

<table>
<thead>
<tr>
<th>Message Unit</th>
<th>Social Identity Within the Narrative</th>
<th>Social Identity Within the Story Telling Event</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Social map of social identities
Appendix D

Discourses strategies, Conventions, In-study Codes, and Themes
**Discourse strategies adapted/modified from Green and Wallat (1981)**

<table>
<thead>
<tr>
<th><strong>Controlling</strong></th>
<th>Message is used to control a person or group’s behavior</th>
<th><strong>Confirming</strong>+</th>
<th>Can be a question or response – non-verbal or verbal; but affirmatory. “Yes” is sufficient or a nod or a statement of agreement are such examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Focusing</strong></td>
<td>Used to begin a discussion. This is often determined by a change in the message. It is either a question or response.</td>
<td><strong>Confirming</strong> -</td>
<td>Message indicates that individual does not accept what has occurred. Could be in the form of “no” or any sort of statement that is not in agreement.</td>
</tr>
<tr>
<td><strong>Focusing Marker:</strong></td>
<td>A way for an individual to mark their place by reminding other individuals that it is their turn to talk</td>
<td><strong>Extending</strong></td>
<td>The addition of new information to any topic.</td>
</tr>
<tr>
<td><strong>Focusing Frame</strong></td>
<td>This differs from a focusing marker in that it precedes a statement. This is more specifically stating that the individual is about to say something significant</td>
<td><strong>Raising</strong></td>
<td>Raises the level of a particular conversation or discussion</td>
</tr>
<tr>
<td><strong>Ignoring</strong></td>
<td>Response that occurs; typically defined when someone else has made a statement directed at the individual who is choosing not to pay attention to the one speaking</td>
<td><strong>Clarifying</strong></td>
<td>To make clear of a previous message – can be a question or response.</td>
</tr>
<tr>
<td><strong>Continuance</strong></td>
<td>A type of action that can be verbal or non-verbal that indicates to the other person that it is alright for this person to keep talking</td>
<td><strong>Refocusing</strong></td>
<td>Brings individuals back to an original topic – e.g., a teacher keeping students on track with a discussion instead of veering to another topic</td>
</tr>
<tr>
<td><strong>Editing</strong></td>
<td>Person is attempting to redefine what they have previously stated. Marked by a word that indicates the person will re-explain themselves</td>
<td><strong>Restating</strong></td>
<td>To repeat; could be a whole phrase or just a portion of it</td>
</tr>
</tbody>
</table>
Discourse conventions in class conversations and discourse templates adapted from Bloome et al., 2005

<table>
<thead>
<tr>
<th>CAPS</th>
<th>Emphasizes higher voice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Italics</td>
<td>Describes non-verbal behavior</td>
</tr>
<tr>
<td>↑</td>
<td>Raised intonation</td>
</tr>
<tr>
<td>+</td>
<td>Elongated vowel</td>
</tr>
</tbody>
</table>
Video Transcript Codes

Identity

- Participating Black female student (Janice)
- Participating Black female student (Darlene)
- Participating Black female student (Bailey)
- Participating Black female student (Brandy)
- Participating Black female student (Amber)
- Participating Black female student – confident (Amber)
- Participating Black female student – anxious (Amber)
- Participating Black female student – reluctant (Amber)
- Participating Black female student (Kylie)
- Participating Black female student – work alone (Kylie)
- Participating Black female student – unsure (Kylie)
- Participating Black female student (Amy)
- Participating Black female student (April)
- Participating Black female student (Maya)
- Participating Black female seeking knowledge (Amber)
- Participating Black female student offering incomplete rebuttal (April)
- Participating Black female student offering rebuttal
- Participating Black female student asking for clarification of claim (April)
- Participating Black female student providing clarification to Black male
  (Bailey and Xavier)
- Helpful Black female student (Maya)
• Helpful Black female student – role of teacher/mother/helpful friend (Kylie)
• Black female acting as friend (Janice)
• Participating Black female friend engaging Black male students (Janice)
• Participating Black female student – role of authority/friend (Bailey)
• Helpful Black female student to Black male student
• Black female student requesting clarification (Kylie)
• Black female student requesting clarification (Amber)
• Black female student requesting clarification (Amy)
• Black female student requesting clarification from group (Bailey)
• Participating Black female disagreeing with teacher’s behavior (Maya)
• Non-participating Black female - silence (Maya)
• Black female student acting as authority to peers (Kylie)
• Black female student acting as authority to peers (Amber)
• Chastising Black female/friend – (Amber)
• Inquisitive Black male student to Black female/friend
• Black male student as “son” to Black female (Darnell and Kylie)
• Participating White female student
• Participating/helpful White female student
• Participating/helpful White female student with claim (Katie)
• Participating friend offering rebuttal to group (with Black female ) (Katie)
• Participating female student of color to group with Black female student (Burmese) – Vicki
• Participating female student of color to group with Black female student (Burmese) offering claim – Vicki
• Participating female student of color to group with Black female student (Burmese) offering reasoning
• Participating female student of color to group with Black female student (Burmese) offering rebuttal
• Participating female student of color to group with Black female student (Burmese) offering scientific evidence
• Participating White female student looking for help from White female student
• Participating White female student asserting role as authority (Lori)
• White female friend to Black female participant – friendship/personal (to Brandy)
• White female student asking for clarification from Black female
• Participating Black male to Black female (Xavier)
• Participating Black male to group (Brian)
• Participating Black male to group – claim (Adam)
• Participating Black male as authority (Jim)
• Participating Black male –general (Darnell)
• Participating/reluctant Black male (Darnell)
• Participating/frustrated Black male (Darnell)
• Participating Black male student seeking clarification from Black female (Xavier and Bailey)
• Participating Black male student with Black female student (Xavier and Bailey)

• Participating Black male student seeking clarification from group (Adam)

• Participating Black male acting as authority/leader (Xavier)

• Participating Black male rebutting another Black male’s claim

• Participating Black male stating claim (Xavier)

• Participating Black male extending claim with Black female (Xavier)

• Participating Black male giving rebuttal to Black female (Xavier to Bailey)

• Participating Black male acting friend (Xavier)

• Clarifying Black male to group (Jim)

• Clarifying Black male to group (Xavier)

• Clarifying Black male to Black female (Xavier)

• Non-participating Black male

• Cooperating Black male (Darnell)

• Cooperating Black male (Xavier)

• Cooperating Black male (Adam)

• Cooperating Black male (with Black female)

• Non-cooperating Black male with teacher

• Non-cooperating Black male with teacher (resisting question) (Darnell)

• Non-cooperating Black male with group (Xavier)

• Agreeing Black male student with Black female student (Darnell and Kylie)

• Participating Black male student with claim with group (Xavier)
- Participating Black male student with claim with Black female student (Xavier and Bailey)
- Participating White male student with claim
- Informing teacher (with Black female) Kylie
- Clarifying teacher - general
- Clarifying teacher with Black female (Amy)
- Comforting teacher to Black female (Amber)
- Teacher requesting clarification
- Acknowledging teacher (to Black female – Kylie)
- Acknowledging teacher (to Black female – Amber)
- Acknowledging teacher (to White male)
- Teacher as authority
- Teacher as expert - general
- Teacher as authority (to Black male)
- Teacher providing direction
- Teacher requesting opinions/facilitating discussion
- Teacher facilitating discussion from Black female (Kylie) comment
- Teacher confirming correct answer (Maya)
- Teacher confirming correct answer (general – to class)
- Teacher offering rebuttal (to White male)
- Teacher facilitating response from Black female (Kylie)
Non-verbal behavior

- **Argumentation Codes**
- **Claim/Rebuttal**
- Attempt at claim – April
- Claim – bailey - logical
- Claim- logical (connection to consequence) April
- Claim – logical – Adam
- Claim – logical - Xavier
- Thesis as claim
- Caring
- *Lack of caring-Bailey*
- *Implicit caring- April*
- Rebuttal to group (April) (2)

Evidence

- Scientific (April)
- Scientific (Bailey) (with edit)
- Scientific (Bailey) (extending)
- Personal
- Topical – April
- Topical – April – connection to country

Reasoning

- Cognitive (April)
- Cognitive (Bailey)
• Affective

Lived Experiences

• Economy – finances
• Economy – finances – with scientific evidence (Bailey)
• Economy – job/career
• Traffic
• Concerned resident
• Crime
• Love of environment
• Environment – effects of ecosystem
• Education – zoo as
• Race
OTHER INTERVIEW CODES – CLASSROOM CODES ARE UNDERLINED

- AFTER SCHOOL JOB- NONE (April)
- AFTER SCHOOL JOB- DESIRE TO WORK (April)
- AFTER SCHOOL JOB – AUTONOMY (April, Bailey, Brandy, Darlene, Amy, Maya)
- AFTER SCHOOL JOB – HELP MOTHER (Brandy, Bailey)
- AFTER SCHOOL JOB – PREPARATION FOR FUTURE (Bailey, April)
- AFTER SCHOOL JOB – MONEY (Amy and Maya)
- BELIEF IN SCIENCE – SOME TOPICS ARE INTERESTING, SOME NOT (April)
- BELIEF IN SCIENCE – EVOLUTION IS INTERESTING April
- BELIEF IN SCIENCE – CREATIONIST BELIEFS April
- BELIEF IN SCIENCE – LIKE CHEMISTRY/MATH – NOT ENVIRONMENTAL (Kylie)
- BELIEF IN SCIENCE – NATURE OF SCIENCE (Amber)
- BELIEF IN SCIENCE – NATURE OF SCIENCE – SCIENCE AS ADVENTUROUS (Amber)

CAREER GOALS

- TEACHER/JOURNALISM (Amber)
- NURSE (Brandy)
- CAREER GOALS – UNSURE (April)
- UNSURE – BUSINESS, PUBLIC HEALTH OFFICER, FORENSICS, SPORTS MED (Bailey)
- DIETICIAN – Kylie
• CRIMINAL JUSTICE OR MARKETING - MAYA
• FAMILY- LOVE- AMBER
• FAMILY – SINGLE MOM – ALL EXCEPT AMBER
• CLOSE WITH DAD - KYLIE
• ACADEMIC/EDUCATION
• ACADEMIC RIGOR OF RIVERWEST (AMBER, BAILEY, BRANDY)
• ACADEMIC SUCCESS (ACADEMIC MOTIVATION) AMBER
• APPRECIATE OF SCHOOL (AMBER)
• PEOPLE PERSON (AMBER)

CLASS DYNAMICS

• SCHOOL – ENVIRONMENTAL SCIENCE CLASS – CLASS DYNAMICS – HOMOGENOUS RACIAL MAKEUP BENEFITS (BAILEY)
• SCHOOL – ENVIRONMENTAL SCIENCE CLASS – CLASS DYNAMICS – VOLUNTEER WRITER IN GROUP ACTIVITIES (april)
• SCHOOL – ENVIRONMENTAL SCIENCE CLASS- CLASS DYNAMICS – VOICE IS HEARD IN SCHOOL (BRANDY)
• SCHOOL – ENVIRONMENTAL SCIENCE CLASS- CLASS DYNAMICS – VOICE IS HEARD IN CLASS (april)
• SCHOOL – ENVIRONMENTAL SCIENCE CLASS- GROUP DYNAMICS – LACK OF GROUP COHESION- WRITING ANSWERS (BRANDY)
• SCHOOL – ENVIRONMENTAL SCIENCE CLASS- GROUP DYNAMICS – SILENT/SHY – DID NOT KNOW GROUP – MAYA (NOT WITH BRANDY)
• SCHOOL – ENVIRONMENTAL SCIENCE CLASS- GROUP DYNAMICS – GROUP AFFINITY – BRANDY KNOWS SHE DOESN’T LIKE VIOLENCE TO ANIMALS OR HUMANS- TOWN HALL SIMULATION (MAYA)

• SCHOOL – ENVIRONMENTAL SCIENCE CLASS- GROUP DYNAMICS – LACK OF GROUP COHESION-NOT CHALLENGING/NO EFFORT (BRANDY)

• SCHOOL – ENVIRONMENTAL SCIENCE CLASS – GROUP DYNAMICS – NEED TO SUPPORT

ENVIRONMENTAL SCIENCE TOPICS

• ENVIRONMENTAL SCIENCE TOPICS – GENERAL – PERSONAL CONNECTION – AT FIRST CARELESS NOW DIFFERENT – RELATED TO NURSING (BRANDY)

• ENVIRONMENTAL SCIENCE TOPICS -GLOBAL WARMING CAUSES – FOSSIL FUELS APRIL

• FOLLOWING INSTRUCTIONS OF ASSIGNMENT (APRIL)

• GLOBAL WARMING CAUSES – HUMAN BEINGS APRIL

• GLOBAL WARMING – HUMAN BEINGS SHOULD REDUCE IT APRIL

• ENVIRONMENTAL SCIENCE TOPICS – GLOBAL WARMING EFFECTS – CHANGE IN ECOSYSTEM (AFFECTS HUMANS) APRIL

• ENVIRONMENTAL SCIENCE TOPICS – GLOBAL WARMING EFFECTS – NO PERSONAL CONNECTION APRIL

• ENVIRONMENTAL SCIENCE TOPICS – HIGH IMPORTANCE OF ENVIRONMENT – HUMANS HABITAT; APRIL
• ENVIRONMENTAL SCIENCE TOPICS – GLOBAL WARMING EFFECTS – NO PERSONAL CONNECTION (APRIL, MAYA)

• ENVIRONMENTAL SCIENCE TOPICS – GLOBAL WARMING EFFECTS – NO PERSONAL CONNECTION (MAYA)

• ENVIRONMENTAL SCIENCE TOPICS – ZOONOTIC VIRUS – PERSONAL CONNECTION (MAYA) – CHANCE OF INFECTION

• ENVIRONMENTAL SCIENCE TOPICS – GLOBAL WARMING EFFECTS – PERSONAL CONNECTION (APRIL)

• ENVIRONMENTAL SCIENCE TOPICS – GLOBAL WARMING EFFECTS – PERSONAL CONNECTION (MAYA) – TUSKS – GRANDMOTHER HAS STATUES – NEVER KNEW CONNECTION

• ENVIRONMENTAL SCIENCE TOPICS – TOWN HALL SIMULATION – NO PERSONAL CONNECTION (APRIL)

• ENVIRONMENTAL SCIENCE TOPICS – ENVIRONMENT – PERSONAL CONNECTION – CARING – SCHOOL (BAILEY)

• ENVIRONMENTAL SCIENCE TOPICS – ENVIRONMENT – PERSONAL CONNECTION – EROSION IN LAND – NOT CARING

• DIFFERENCE ENVIRONENTIAL SCIENCE TOPICS – NO RELATION TO RACE AND GENDER – AFFECTS ALL OF HUMANITY. COLLECTIVE IDENTITY (APRIL)

• ENVIRONMENTAL SCIENCE TOPICS – TOWN HALL SIMULATION – HIGH POLLUTION APRIL
• ENVIRONMENTAL SCIENCE TOPICS – TOWN HALL SIMULATION – ECONOMY SUPERCEDES NATURE PARK (BAILEY)

• ENVIRONMENTAL SCIENCE TOPICS – TOWN HALL SIMULATION – CONCERN FOR ANIMAL PLACEMENT (DUCKS) (MAYA)

• ENVIRONMENTAL SCIENCE TOPICS – TOWN HALL SIMULATION – NEED FOR PARK FOR INTERACTION OF COMMUNITY (MAYA)

• ENVIRONMENTAL SCIENCE CLASS - GROUP DYNAMICS – GROUP AFFINITY – BRANDY KNOWS SHE DOESN’T LIKE VIOLENCE TO ANIMALS OR HUMANS- TOWN HALL SIMULATION (MAYA)

• ENVIRONMENTAL SCIENCE TOPICS – TOWN HALL SIMULATION – NATURE PARK SUPERCEDES ECONOMY (BRANDY)

• ENVIRONMENTAL SCIENCE TOPICS – TOWN HALL SIMULATION – BUSY ECONOMY/ CRIME/TRAFFIC (BRANDY)

• ENVIRONMENTAL SCIENCE TOPICS – TOWN HALL SIMULATION – POLLUTION (BAILEY)

• ENVIRONMENTAL SCIENCE TOPICS – TOWN HALL SIMULATION – MONEY NOT THAT IMPORTANT COMPARED TO ENVIRONMENT

• ENVIRONMENTAL SCIENCE CLASS – NOT A LOT OF DEBATE (APRIL)

• SCHOOL – ENVIRONMENTAL SCIENCE CLASS – DOES NOT ENJOY ENVIRONMENT (KYLIE)

• ENGAGEMENT TO TOPIC - NOT ENGAGED TO TOPIC (AMBER, KYLIE)

• ENGAGEMENT TO TOPIC - SCHOOLS SET UP TO ENGAGE STUDENTS (KYLIE)
• ENGAGEMENT TO TOPIC - ENVIRONMENTAL SCIENCE TOPICS – NO INTEREST IN ADDITIONAL TOPICS (APRIL)

• ENVIRONMENTAL SCIENCE TOPICS - NOT LIMITED TO BLACKS BUT EVERYONE (AMBER AND APRIL)

• ENVIRONMENTAL SCIENCE TOPICS - CONCERN ABOUT CONTENT AND HOW IT MATCHES TO AP TEST

FRIENDSHIP

STRUGGLES (AMBER)

WITH MAYA – RESPECT- GROUP AFFINITY (BRANDY AND MAYA)

IDENTIFY WITH RACE

• MAYA – MAE JAMISON, LEFT EYE

• APPRECIATIVE OF ANCESTORS – MAYA, AMY

PEDAGOGICAL CONFUSION

• CONFUSING OVER CER-WORKSHEET (AMBER, AMY, KYLIE)

• GRADING ISSUES – BRANDY

• LACK OF EXPLANATIONS/TEACHER DOESN’T CARE IF YOU UNDERSTANDN OR NOT – UNLIKE CHEMISTRY – KYLIE

• CASE STUDY- NO INSTRUCTIONS GIVEN – KYLIE

• SCIENCE DISCOURSE ISSUES – NO PROBLEM WITH MAYA/PROBLEM WITH KYLIE

• PERSONAL BELIEFS – PRETTY RELIGIOUS (APRIL)

• PERSONAL BELIEFS – RELIGION IS A WAY OF LIFE APRIL)

• PERSONAL BELIEFS – RELIGIOUS IS A PART OF HER APRIL)
• PERSONAL BELIEFS – RELIGION INTERSECTS WITH SCHOOL CLASSES
  (ONLY EVOLUTION IN SCIENCE) APRIL)
• PERSONAL BELIEFS – RELIGION INTERSECTS WITH SCHOOL –
  ENVIRONMENTAL CLASS - HALLOWEEN (APRIL)
• PERSONAL CONNECTION TO ENVIRONMENTAL SCIENCE
SCHOOL
• SCHOOL-CLASSES- HOMOGENOUS RACIAL MAKEUP –RACISM (APRIL)
WHITE
• SCHOOL- HOMOGENOUS – STICK WITH OWN KIND - BLACK
• SCHOOL CLASSES- AVOIDANCE OF AP (APRIL)
• SCHOOL-CLASSES-RES-REGULAR (APRIL)
• SCHOOL-STUDENTS –DIVERSITY (APRIL, BRANDY, MAYA)
• SCHOOL-STUDENTS –DIVERSITY SCHOOL-STAFF-MOSTLY WHITE
  (APRIL)
• SCHOOL-STAFF-MOSTLY WHITE-OK(APRIL)
• SCHOOL-STAFF-MOSTLY WHITE-NO DIFFERENCE IN INSTRUCTION
  (APRIL)
• SCHOOL – DIVERSITY – IMPORTANCE OF DIFFERENT PERSPECTIVES TO
  OFFER INSIGHT; SCHOOL – DIVERSITY - ENCOURAGE ELL LEARNERS
  (APRIL, BRANDY, MAYA)
• SCHOOL – MENTOR- WARFIELD – MAYA AND JANICE
• SCHOOL – ENVIRONMENTAL SCIENCE CLASS - CLASS DYNAMICS –

VOICE IS HEARD IN CLASS (APRIL)

• SCHOOL – STUDENTS MOSTLY CREATE DIVERSITY (APRIL)

• SCHOOL – DIVERSITY – SOME/ALL STUDENTS OPEN-MINDED/NON-JUDGEMENTAL (APRIL, BRANDY)

• SCHOOL ACTIVITIES

• SCHOOL – EXTRACURRICULAR – SPORTS (TRACK, BASKETBALL, JANICE) – BAILEY, KYLIE, JANICE

• SCHOOL – EXTRACURRICULAR – THEATRE, CHOIR - MAYA

• SCHOOL-EXTRACURRICULAR ACTIVITIES – NONE- NO REASON(APRIL)

• SCHOOL – CLASS- DRAWING(APRIL)

• SCHOOL - EXTRACURRICULAR ACTIVITIES – NONE – TRANSPORTATION ISSUES DUE TO IMPORTANCE APRIL)

SIBLINGS -

• MIDDLE CHILD (LITTLE SISTERS AND OLDER BROTHER – BAILEY)

• MIDDLE CHILD (AMBER)

• MIDDLE CHILD (TWO OLDER BROTHERS, OLDER SISTER, YOUNGER SISTER) DEATH IN FAMILY?? – BRANDY

• SIBLINGS – CARETAKER – “MOM”- BRANDY

• MIDDLE CHILD – KYLIE – TWO SISTERS AND BROTHER ON MOM’S SIDE, DAD’S TWO BROTHERS AND A SISTER. SHE IS SECOND TO YOUNGEST

• YOUNGEST – MAYA – OLDER BROTHER IS AUTISTIC AND OLDER SISTER

WHY ENVIRONMENTAL SCIENCE
• RECRUITMENT (AMBER)

• MISUNDERSTANDING (PROJECT-BASED COURSE) (DARLENE, BRANDY, APRIL)

• EASY CLASS (BRANDY)

• EASY A FOR AN AP CLASS (KYLIE)

• ENVIRONMENTAL SCIENCE CLASS – CHOICE OVER FORENSIC SCIENCE (APRIL)

• INTEREST/ENJOYMENT IN ENVIRONMENT (BAILEY)

• REGRETS BEING IN CLASS - KYLIE

• CAREER GOALS (BAILEY)

• APPRECIATION FOR SCIENCE (AMBER)

USE OF ARGUMENTATION IN INTERVIEW

• USE OF CLAIM, PERSONAL EVIDENCE, AND REASONING IN INTERVIEW (AMBER)

MAYA

• COULD NOT RELATE TO TOWN HALL SIMULATION

• PERSONAL EVIDENCE

• PERSONAL REASONING

• CHASED BY MONKEY (PERSONAL EXPERIENCE)

• USE OF CLAIM IN INTERVIEW – SAID THAT TAKING PICS WAS HELPFUL BUT OTHER PEOPLE MAY NOT CARE ABOUT THE ENVIRONMENT - MAYA
Appendix E

Presentation Boards
Overview Questions

   *Reduce poaching & hunting*
   *Successful bill the information they learned*  
   Ex: polar bears & sharks

2. All have responsibility  
   - natural resources & economic growth
   Environmental = economic & economies depend on environmental success

3. Without awareness, animals will become extinct
   - global environment will change without animals  
   Ex: chain reaction

4. It relates to us human & can be affected by animals & their ecosystem

5. We would support polar bears. Government involvement, community service, schools
   Challenges = working together & polar bear priorities
4. Some animals carry zoonotic viruses, and people eat the animals then travel to different countries.

- The kind of animals they kill.
- No, because humans are more important than animals.
- The humans should be more specific of what animals they kill and eat.
- The reason is because humans are getting sick by some animals they eat.

5. Some of these animals are the only thing people want to eat.

- Doctor Nathan uses filter papers to check what type of viruses the animals carry.
- People need to be aware of what they eat and take care of their health.
1) Depends on where you are located
   - Ecological
     - Biology
     - Health
   - Manner in which its used
   - Economic development
     - Bringing in money
     - Producing/Products
   - If not addressed the species that are lost will affect the rest of the animals within ecosystem

4) They can affect in many ways because we use the same resources as animals.

5) An environmental cause to them would be under because its a universal resource.

Overall:
   - Saving money
   - Everything we do affects the ecosystem
   - Raising awareness maybe a change because not everyone will agree.