HIDDEN STUDENT VOICE: A CURRICULUM OF A MIDDLE SCHOOL SCIENCE CLASS HEARD THROUGH CURRERE

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HIDDEN STUDENT VOICE: A CURRICULUM OF A MIDDLE SCHOOL SCIENCE CLASS HEARD THROUGH Currere

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Students have their own lenses through which they view school science and the students’ views are often left out of educational conversations which directly affect the students themselves. Pinar’s (2004) definition of curriculum as a ‘complicated conversation’ implies that the class’ voice is important, as important as the teacher’s voice, to the classroom conversation. If the class’ voice is vital to classroom conversations, then the class, consisting of all its students, must be allowed to both speak and be heard. Through a qualitative case study, whereby the case is defined as a particular middle school science class, this research attempts to hear the ‘complicated conversation’ of this middle school science class, using currere as a framework. Currere suggests that one’s personal relationship to the world, including one’s memories, hopes, and dreams, should be the crux of education, rather than education being primarily the study of facts, concepts, and needs determined by an ‘other’. Focus group interviews were used to access the class’ currere: the class’ lived experiences of science, future dreams of science, and present experiences of science, which was synthesized into a new understanding of the present which offered the class the opportunity to be fully educated. The interview data was enriched through long-term observation in this middle school science classroom. Analysis of the data collected suggests that a middle school science class has rich science stories which may provide insights into ways to engage more students in "science". Also, listening to the voice of a science class may provide insight
into discussions about science education and understandings into the decline in student interest in science during secondary school. Implications from this research suggest that school science may be more engaging for this middle school class if it offers inquiry-based activities and allows opportunities for student-led research. In addition, specialized academic and career advice in early middle school may be able to capitalize on this class’ positive perspective toward science. Further research may include using currere to hear the voices of middle school science classes with more diverse demographic qualities
DEDICATION

I would like to dedicate this work to my spouse, John,
and my children, Elizabeth, Amy, and Andrew.

Never stop learning!
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CHAPTER I
INTRODUCTION

Science education, particularly during the past 60 years, has been linked to this country’s world dominance, both politically and economically. Events such as the successful launching of the Russian satellite Sputnik in 1957, and federal reports with such titles as *A Nation at Risk* (1983), *Before It’s Too Late* (2000), and *Rising Above the Gathering Storm* (2005) have served as bellwethers to remind us of the import of scientific knowledge and understanding toward this country’s maintaining its position as an international power (Bybee, 2007; Duschl, Schweingruber, & Shouse, 2007; Maltese & Tai, 2010). The federal government’s current Race to the Top initiative, which in 2009 provided for a fund of $4.35 billion toward educational reform, has as one of its main tenets to “prepare students to succeed in college and the workplace and to compete in the global economy” (U.S. Department of Education, 2009).

In the 1990s the term STEM was coined to collectively refer to the areas of science, technology, engineering, and mathematics, although for a time the state of Missouri referred to these areas as METS: Mathematics, Engineering, Technology, and Science (Bybee, 2010; Christie, 2008; Sanders, 2009). An educated STEM workforce is often viewed as integral to the political and economic success of a technologically advanced global society (Chubin, Donaldson, Olds, & Fleming, 2008; Committee on Science, Education, & Public Policy, 2007; Simpkins, Davis-Kean, & Eccles, 2006;
Subotnick, Tai, Rickoff, & Almarode, 2010; Young, 2005). The STEM pipeline is a term most often used to describe the educational passage through secondary school to graduate with a degree in a STEM field (Metcalf, 2010).

Leakages in the pipeline, key places and reasons that students leave this academic passage toward a STEM degree, continue to be of concern to many (Adamuti-Tache & Andres, 2008; Blickenstaff, 2005; Fifolt & Searby, 2010; National Academy of Science 2005, 2010). Reports show that ethnic minorities and women continue to be underrepresented in STEM disciplines (Adamuti-Tache & Andres, 2008; Fifolt & Searby, 2010; Metcalf, 2010; Simpkins et al., 2006; Whalen & Shelley, 2010; Young, 2005). Students continue to leave high school unprepared for college level courses, particularly in the areas of mathematics and science. This lack of preparation subsequently affects the number of students who are able to complete college courses in these areas (American Association of State Colleges and Universities, 2005; Bound, Lovenheim, & Turner, 2010; Committee on Science, Education, & Public Policy, 2007; National Academy of Science, 2010; Osborne, 2003; Sadler & Tai, 2007). Studies suggest that the number of graduates in engineering in countries like India and China is increasing, while the number of U.S. citizens earning engineering degrees is declining (Chubin et al., 2008; Committee on Science, Education, & Public Policy, 2007; Darling-Hammond, 2010; Tai, Liu, Maltese, & Fan, 2006).

If the STEM pipeline is the educational path one needs to follow in order to successfully complete a degree in a STEM field, then the pipeline actually begins much earlier than secondary school (American Association of State Colleges and Universities, 2005; Panizzon & Westwell, 2009; Tytler, Osborne, Williams, Tytler, & Clark, 2008).
Course selections and topic preferences in elementary and middle school can have considerable consequences on a student’s future career path (Eccles, Vida, & Barber, 2004; Osborne, Simon, & Collins, 2003; Scherz & Oren, 2006; Simpkins et al., 2006). The importance of course selection for students in middle school coincides with a time in students’ lives when their interest in science and mathematics begins to decline (Barmby, Kind & Jones, 2008; Liu, Hsieh, Cho, & Schallert, 2006; Osborne et al., 2003; Singh, Granville, & Dika, 2002; Tytler et al., 2008).

While the level of a student’s middle school mathematics class may seem somewhat incidental, course choices made at this time can greatly affect the ease with which a student pursues a STEM-related career field (Eccles, Adler, & Meece, 1984; Sadler & Tai, 2007; Simpkins et al., 2006; Singh et al., 2002; Van Langen & Dekkers, 2005). The current movement toward student completion of algebra by eighth grade is evidence of the recognition of the level of mathematics required to be successful in post-secondary mathematics and science courses (Gamoran & Hannigan, 2000; Singh et al., 2002; Spielhagen, 2006). Spielhagen (2006) describes algebra as “the gatekeeping course to advanced study in both mathematics and science” (p. 31); students’ participation in this course in middle school leaves open more options for course participants to pursue higher level math and science courses, not only in high school but also in college. Taking more academically rigorous mathematics and science courses in high school is influential in students’ choosing a major in mathematics or science (Adamuti-Tache & Andres, 2008; Gehrke, Knapp, & Sirotnik, 1992; Simpkins et al., 2006; Trusty, 2001). Therefore, specific efforts to encourage students in the middle grades to develop a solid foundation
of mathematics and science understanding are important to increasing the number of students interested in pursuing higher education and careers in STEM areas.

**Science in Middle School**

The term middle school refers to a school with some configuration of grades from fifth through eighth that is governed by a philosophy that recognizes the unique needs of students of this age (Association for Middle Level Education [AMLE], 2011; George, Lawrence, & Bushnell, 1998). During the years of early adolescence, typically between 10 and 15 years of age, students go through a number of physical, emotional, mental, and intellectual changes. There is great variability among individuals as to when these changes occur, which can lead to social and relational changes among students and their peers, their family, and the world at large. Middle schools choose to advocate for students during this sometimes turbulent time, offering support, guidance, and meaningful learning opportunities in the academic learning environment (NMSA, 2010).

Middle school science courses are most often an integrated science, consisting of a mix of life science, physical science, and earth science (Hurd, 2000). Science was initially taught to students in this age range as a way of encouraging the students to pursue further science education in secondary school (Hurd, 2000; Smith 2010). Science continues to be taught in school in order to prepare students for higher level science classes and to prepare a scientifically literate population (Smith, 2010).

**Student Voice**

“The problem, after all, is not with the voices that speak but with the ears that do not hear.” (Casey, 1995, p. 223)
Students’ personal experiences affect how they understand, interpret, and relate to that which occurs in the classroom. Students have their own lenses through which they view schools and students’ views are often left out of many equations which directly affect the students themselves: school environment, content, and instruction (Rudduck & Flutter, 2004). Educational researchers are beginning to realize the significant nature of student voice (Bergmark, 2008; Bernhardt, 2009; Cook-Sather, 2002, 2007, 2009; DeFur & Korinek, 2009; Fielding, 2001; Mitra, 2008; Mitra & Gross, 2009; Rudduck & Flutter, 2004). As explained by Cook-Sather (2006), student voice suggests more than just vocalization; it implies that students are involved in conversations in which they are meaningful participants. Student voice can provide an insight into the teacher-student and content-student relationships (Rudduck & Flutter, 2004).

Students are participants in their own education in that the students bring with them to the classroom their own experiences. Each student then integrates his own unique experiences with the content that is taught in the classroom and with the knowledge and experiences of others in the classroom. Yet student experience is often left out of classroom instruction. Brooker and Macdonald (1999) suggested that “while the curriculum supposedly exists to serve the interests of learners, their preferences, if sought at all, are marginalized and their voices are mostly silent in curriculum making” (p. 84). Hearing the voice of the students and understanding the science beliefs that the students bring with them to the classroom may help to better engage the students in the science they learn. Logan and Skamp (2008) suggest that “the importance of listening to and heeding the students’ voice may be an even more critical concern in addressing the decline in students’ attitudes and interest in science” (p. 501).
Curriculum

Although the term curriculum is often used synonymously with the word content, curriculum is actually a more problematic term. The term content is static; it is that information that is given to the teacher which is then passed onto the student. Content evokes Freire’s (1970/2006) banking model of education, in which the student is the vessel to be filled with appropriate knowledge by the teacher who is the container of that knowledge.

Using Pinar’s (2004) definition of curriculum as a ‘complicated conversation’ implies that there is more than one voice involved in the dialogue which is curriculum. Considering curriculum as conversation implies “engaging live human beings in activities of meaning-making, dialogue, and reflective understanding of a variety of texts, including the tests of their social realities” (Greene, 1995, p. 305). St. Julien, Trueit, Doll, and Fleener (2006) described this concept of curriculum as “a dance of interaction between and among the teacher and the students” (p. 248). Thinking of curriculum as conversation suggests that student voice is one which is important, just as important as the teacher’s voice, to the classroom conversation.

If student voice is vital to the classroom conversation, then the student must be allowed both to speak and be heard. A student’s voice carries with it experiences and understandings that are important to that particular student. The conglomeration of the student voices in a classroom, along with the voice of the teacher, is what provides the ‘complicated conversation’ – the curriculum – of a classroom.

In order to elicit the voice of the science classroom, the concept of currere is used as a framework for this study. The idea of currere asks one to contemplate her personal
past, future, and present as “an autobiographical strategy by means of which one may understand the nature of one’s life in schools, and the functions of school in one’s life” (Pinar, 1975/1994, p.). *Currere* suggests that one’s personal relationship to the world, including one’s memories, hopes, and dreams should be the crux of education, rather than education being primarily the study of facts determined by an ‘other’. Pinar, Reynolds, Slattery, and Taubman (1995) offer that *currere* “seeks to understand the contribution academic studies makes to one’s understanding of his or her life” (p. 520).

Kincheloe (1998) explains that *currere* “concerns the investigation of the nature of the individual experience to the public” (p. 129). Curriculum as *currere* is a “multifaceted process . . . the ‘complicated conversation’ of the participants” (Pinar, 2001, p. 27). There are no boundaries between school, the subject matter, and the student – each influences and is influenced by the other. Whatever the subject matter taught in a classroom, it is experienced by all involved in a particular manner. Each involved with the topic brings with him his own understandings and develops within himself his own knowledges (Sumara & Davis, 1998).

*Currere* provides a framework for the class to explicate the place of science in the lives of its students, but not in a static sense, as in “what did you do in science today?” *Currere* conveys a sense of motion and connectedness. In this case study, *currere* requests that the science class consider the prevalence of science in their lives, from the earliest memories to the far off dreams. Through the use of *currere*, the participant is then asked to re-understand the place of science in his life, from this perspective of science throughout his life.
Through the use of *currere*, the students in the class are encouraged to include their voices to the conversation of the science classroom. By engaging in *currere*, the class is encouraged to consider the science evident in their past, future, and present. By the time they are in middle school most students know the rules of school, whether they follow them or not. Students at this age are good at telling adults what they want to hear. “Students gain voices they are encouraged to have; they lose those that are less valued” (Batchelor, 2006, p. 799. This inquiry encourages the students in this class to be involved in the conversation. This inquiry invites the class to think past those answers that the teachers expect to hear, to concentrate on what they see in themselves, and to share this with an adult interested in and listening to its stories.

The concept of *currere* provides the framework for this study. Because *currere* is an autobiographical method, my voice, the voice of the researcher, is one that is heard throughout the research along with the voice of the class. I am involved in my own *currere* as I examine my interest and understanding in the student voice in science. I encourage the reader to take part in his own *currere* throughout his reading in order to learn about his own understandings and ponder his personal experiences of science.

**Statement of the Problem**

It is well documented that many students in the United States, as well as students internationally, leave studies of mathematics and science prior to or during post-secondary education (Chubin et al., 2008; Committee on Science, Education, & Public Policy, 2007; Jacobs & Simpkins, 2005; Moses, Howe, & Niesz, 1999; Sanders, 2008/2009; Young, 2005). Studies suggest that middle school is a critical point in
students’ careers in determining their future academic pathways (Eccles et al., 1984; Eccles et al., 2004; Osborne, 2007; Simpkins et al., 2006; Spielhagen, 2006; Tai et al., 2006). Students who do not take appropriate mathematics and science course work in middle school can have a difficult, if not impossible, route toward a college major in a STEM area.

Middle school is also a time when students begin to lose interest in science (Bennett & Hogarth, 2009; George, 2006; Osborne et al., 2003). If one purpose of science education is to produce students who can be engaged in science, then it is important to understand why students become disengaged in school science. Listening to students and understanding the curriculum of a middle school science class – their “complicated conversation – will allow for a more personal view of students’ understandings of science and possibly an insight into why students of middle school age begin to lose interest in this area.

This qualitative research is structured as a case study narrative. The case is a middle school science class, specifically a seventh grade integrated science class. The students in this class provide the experiences which make up the science understandings of the class as a whole.

**Research Question**

This study attempted to hear the voice of the students in a middle school science classroom. Using curriculum as a “complicated conversation” and *currere* as a framework, this study sought to make conscious the curriculum in a middle school
science class. Therefore, the research question in this inquiry was: How is curriculum lived by a middle school science class?

**Research Subquestions**

Using *currere* as a framework allowed the students’ voices to come forward to form the narrative of the middle school science classroom. *Currere* provides the class the opportunity to reflect on science experiences in the past, dream about science possibilities in the future, and integrate these ideas from the past and future into the experience of science in the present. Therefore, the research subquestions in this inquiry were:

**RQ1:** What lived experiences does a middle school science class bring to the science classroom?

**RQ2:** What future relationship with science does a middle school class foresee?

**RQ3:** What are the everyday experiences of a middle school science class?

**Significance of Study**

This study was significant in several ways. First, it attempted to establish the voice of a middle school class as that of a valid member of the science education discussion. Secondly, it recognized that students in a middle school class have significant experiences that they are able to articulate in a way worthwhile to conversations about science education. Lastly, it recognized the process of *currere* as a valid method to explore one’s experience and develop one’s personal curriculum. In addition, this research recognized curriculum not as the content that is taught in the classroom, but as one’s sum of experiences, understandings, and dreams brought with them to the classroom.
This research attempted to go further than exploring how students “participate in and make sense of, develop within and shape what happens in classrooms and schools” (Cook-Sather, 2007, p. 829). This research attempted to integrate the students’ being: past, present, and future into these experiences. It suggested that there are stories that a class has to tell, stories that includes not only the here and now, but also where the students in the class have been and where they hope to go.

Research suggested that middle school, rather than secondary school, is the time when students being to make career and education choices about STEM areas (Archer et al., 2010; Osborne, 2007; Maltese & Tai, 2010, Tai et al., 2006). Understanding the curriculum of a middle school science class would allow an insight into the class’ interests, experiences, and desires, where they are in their career aspirations and where they hope to be one day. These understandings would provide a valuable window into the middle school science experience, allowing others to see how the students want to be engaged, in what they want to be involved, and where the students see themselves in the future. Jenkins (2006) remarked that “the more that is known about students’ interests, enthusiasms, dislikes, beliefs, and attitudes, the more feasible it will be to develop school science curricula that will engage their attention and help to reduce long-standing gender and other differentials” (p. 52). Understanding the class’ voice may allow for more effective use of resources expended toward engaging middle school students in STEM areas.
**Delimitations**

A seventh grade science class was selected as the case for this study. When I was a teacher in a middle school science classroom, I experienced each class to have an individual personality due to the particular interactions that occurred between the specific individuals in each certain class. Each science class constructed its own social reality. It is the sum of the individuals, the experiences, and the interactions that make up the *currere* for the specific class I researched. While this research describes the social reality of this particular class, other science classes would have their own science stories waiting to be heard.

**Assumptions**

In any research study there are assumptions that are made, primarily because of one’s inability to control all variables that may affect the outcome of the study. The following assumptions should be kept in mind by those reading this research. These assumptions help to define the research from my perspective.

1) As the individual is the sum of her experiences, so is a particular group, a school class, defined by its individuals. It is this group of individuals, at this certain place at this certain time which makes up a specific set of experiences shared by this group of people.

2) In this research, the disciplines of STEM (science, technology, engineering, and mathematics) and variations thereof are used interchangeably. The experience of the class through seventh grade has been one of integrated science. The class participated in school-wide STEM activities during my
research, which again blurred the lines between and among science and the other STEM disciplines. Therefore, the research base for this study is related to STEM education and to the individual disciplines within STEM.

3) The discussion of topics in this study is one that is taking place in many countries throughout the world. Many countries are facing similar issues of students losing interest in science long before career decisions are made, thereby leaving a dearth of science majors in the college student population. Some studies that are cited may be from other countries, but the information gleaned from the study corroborates data similar to that of studies in the United States.

4) “Keep in mind, however, that it is I who put the themes there. I did not find them, discover them, or uncover them; I imposed them” (Wolcott, 1994, p. 108). As with any qualitative research project, this project has been influenced by the sum of my experiences, including my experiences as a teacher and researcher.

**Autobiographical Comments**

Somehow in the 20th century many have lost touch with themselves and have created destructive labyrinthine metal cities to get lost in, literally and metaphorically. In academe, this has meant the abandonment of self-study, the loss of status of the humanities, the disciplines currently closest to self-study, and the rise of behaviorism, a reflection of our estrangement and our outer-centeredness, hence bondage to the world of stimulus and response. (Pinar & Grumet, 1976, p. 21)

This study has personal meaning for me, the researcher, on many levels. This study has mirrored the search for my own science curriculum, my search and analysis of
my personal experiences with science. As my voice is one that is heard throughout the research, I attempted to bracket my personal thoughts and experiences, so as not to muddy those of the class. While working back and forth between the experiences of myself and the subjects, I have come to a greater understanding of my personal story of science, which in turn allowed me to interact more fully with the data collected during this research.

This research is one close to my heart, and it allowed for a great deal of personal and intellectual growth for me as the researcher. As I formerly taught middle school science, time in a similar classroom as a researcher allowed me to critique my own understanding of how, why, and what I teach. It is my hope that this research has allowed for a more valuable glimpse into the life of a middle school science class.

Definitions and Operational Terms

**Case.** The unit of study; for this research, a seventh grade science class.

**Class.** The case for this research, naturally bounded as the particular group of students at the school that meets for science class in a specific location at a specific time each day.

**Content.** This term is used to denote the information and concepts that are taught in the classroom.

**Curriculum.** “A complicated conversation” (Pinar, 2001, p. 27).

**Currere.** “An excavation of the lived – including historical – relations among self, society, and subject matter” (Pinar, 2001, p. 6).
**Instruction.** “Education thus becomes the act of depositing, in which the students are the depositories and the teacher is the depositor. . . . Knowledge is a gift bestowed by those who consider themselves knowledgeable upon those whom they consider know nothing” (Freire, 1970/2006, p. 72).

**Middle School.** A school with some configuration of grades five through eight which recognizes and responds to the unique needs of students during this stage of life (AMLE, 2011).

**Narrative.** The structure that encompasses multiple stories on a topic.

**School.** “Schools are places that are actively involved in a high stakes agenda of creating futures for some young people (while denying others)” (Smyth, 2006b, p. 35).

**School Science.** School science is the traditional science content that is typically taught in schools.

**STEM.** The term STEM refers to the content areas of science, technology, engineering, and mathematics.

**Student.** In this research, student refers to a student in the seventh grade, a student who is typically about 12-13 years of age.

**Student voice.** The experiences, memories, hopes, dreams, and understandings of a student, as they would be shared with a trustworthy friend.

**Summary**

The large number of students who dropout of the STEM pipeline at some point in their academic career is of concern to many. While much research has focused on why students drop out of these majors in college, researchers are beginning to place more
emphasis on students at the secondary level and the choices they make in high school regarding STEM. It is also important to recognize that middle school plays an influential role in whether or not students eventually pursue a major in a STEM field. Yet few studies have talked to the students to gain an understanding of where they are, where they have been, and where they see themselves in the future.

This study attempted to make evident the curriculum of a middle school science class. The research subquestions ask what lived experience does a middle school class bring with it to the classroom, what future relationship with science does a middle school class foresee, and what are the everyday experiences of a middle school science class. The significance of this study was the opportunity to explicate the experience of a middle school science class from the position of the class itself. This study allowed an important voice in the discussion of science education to be heard and hopefully to influence future directions in science education.
CHAPTER II
LITERATURE REVIEW

“When we tell our tales, we give away our souls” (Hillman, 1972, p. 182).

This chapter presented a summary of the literature relevant to the concepts represented in the research. This research represented a journey on many levels. It explicated my personal journey of understanding, my currere (Pinar, 1975/1994) related to science and science education. My lived experiences led me to this inquiry and the inquiry itself invited a middle school science class to take a journey through its own lived experiences of science (Clandinin & Connelly, 2000; Geelan, 2007; van Manen, 1990; Wolcott, 1994). It is intended that the reader will, as well, encounter memories and fantasies of his own lived experience of science as a result of interacting with this research.

This literature review begins where the story begins, with a discussion of currere. This is followed by explanations of the larger concepts of story and narrative. From here I engage in my personal currere, sharing my stories of science through which I explain how I came to this inquiry. Sharing my story also allows for a review of literature relevant to science education, school science, and curriculum. This chapter then moves to a discussion about science education in the middle school. The chapter ends with my currere once again, as I share my progressive, or thoughts about my future relationship with science.
The Concept of Currere

The concept of currere provides a framework for this research. Currere was proposed by Pinar (1975) who offered it as a way to reconceptualize curriculum. This concept of currere evolved in opposition to the understanding of curriculum as the content that is studied in the classroom. Pinar (1975) and Pinar and Grumet (1976) proposed that curriculum is not static and divorced from self, but that curriculum is personal and integrated in self-knowledge, self-understanding and self-history. To arrive at this understanding of self in relation to the larger world, Pinar (1975) proposed the concept of currere.

The word currere comes from the Latin meaning to run a course. Using the word in this way allows it to be used as a verb, rather than the noun form “curriculum.” Therefore, currere as a verb implies motion, a moving toward a goal, “a journey of becoming a self-aware subject capable of shaping his or her life path” (Kinzeloe, 1998, p. 130). As suggested by Rosenthal (1991), currere emphasizes the running of the course, rather than the course itself. “Currere compels us to focus on the moment – or more accurately perhaps, on the weaving together of moments into lives” (Sumara & Davis, 1998, p. 84).

The concept of currere moves the understanding curriculum completely out of the public sphere into the personal, private, autobiographic sphere of the individual. Currere assumes that one’s educational experience comes from within. Sumara and Davis (1998) positioned currere as not a “prescription for curriculum” but rather “a proscription – a movement toward thinking in terms of what is possible (based on what we know to be impossible) rather than focusing on what someone else has decreed must be” (p. 88).
Using *currere* as a model, curriculum is now not the teacher telling the student or the content telling the teacher what to teach, it is the individual that fashions his own educational experience based on his own lived experiences and his hopes and dreams. Pinar and Grumet (1976) asked, “[W]hat has been and what is now the nature of my educational experience?” (p. 52). It is the individual’s personal relationship to this experience with the world at large which is primary to the individual’s educational practice. As stated by Trumbull (1990), “our ways of describing and naming the world shape the realities in which we live and limit the possibilities we can see” (p. 163). If one does not start at understanding the context of his own world, then how can he move toward an understanding of anything else?

The method of *currere* as suggested by Pinar (1975/1994) has four steps – the regressive, the progressive, the analytical, and the synthetical. Moving through these steps positions an individual in a “structure of lived meaning that follows from past situations, but which contains, perhaps unarticulated contradictions of past and present as well as anticipations of possible futures” (Pinar, 2004, p. 36). The first step, the regressive, invites one to revisit her past, while the progressive stage invites one to imagine her future. The analytic phase asks one to consider “How is the future present in the past, the past in the future, and the present in both?” (Pinar, 2004, p. 37; Pinar & Grumet, 1976, p. 60; quoted in Pinar et al., 1995, p. 520).

In the synthetical phase of *currere* one is then asked to consider “what is the meaning of the present?” (Pinar, 1994, p. 26) based on the notions with the regressive, progressive, and analytical. The synthetical phase is the “coursing, as in an electric current. The work of the curriculum theorist should tap this intense current within, that
which courses through the inner person, that which electrifies or gives life to a person’s
energy source” (Doll, 2000, xii). It is this synthesis of one’s experiences and
understandings that enable one to be fully in the present. This synthesis allows one to be
truly educated.

*Currere* allows one to experience the positives and negatives of one’s experience
with the world. It gives one the chance to experience the world in which he exists. With
this knowledge, one can then work to change oneself for the better. Kincheloe (1998)
suggested that *currere* is “asking us to become action researchers of ourselves” (p. 133)
in an effort to examine how the world in which one lives effects how one experiences that
world. This allows one to begin to “why they see what they see” and coming to the
understanding that there is no “value-neutral way of perceiving” (Kincheloe, 1998, p.
134).

In order to engage the participants in this research in the action of *currere*, it was
necessary for me as the researcher to experience *currere*. Engaging in my own *currere*
allowed me to examine my own experiences with school, with science, and with school
science. It encouraged me to envision school science as I dream it will be in the future.
Clandinin and Connelly (1991) explained that “deliberatestorying and restorying one’s
life . . . is, therefore, a fundamental method of personal (and social) growth: It is a
fundamental quality of education” (p. 259). My experience with *currere* compelled me
to reflect upon and understand my experiences with science and to develop a purpose for
my role in science education.

*Currere* provides an avenue to access the narrative of a middle school class.
*Currere* allows the class to tell the individual stories that make up their collective
narrative, to provide a look at the participants’ past experience with science, their dreams for how science will play a role in their future, and the understandings that science maintains in their present. By teasing out the currere of the class, a new understanding of the students and their relationship with science comes forward.

**Story**

Story is an integral part of human relationships and reflects the understanding that humans are, by nature, social creatures (Bruner, 1991; Clandinin & Connelly, 1991; Novak, 1975; Polkinghorne, 1988; Vygotsky, Cole, John-Steiner, & Scribner, 1978). Children first learn through story. In the Christian tradition, Jesus used parables to illustrate his message. Much of human history was passed down through generations by stories. A story can help one to understand what it is like to be someone else, somewhere else, involved in something else. While a picture provides a snapshot of time, a story can complete the rest of the picture by adding those things that can’t be seen: context, background, emotion (Chase, 2005; Duff & Bell, 2002).

Van Manen (1990) suggested that “the narrative power of story is that sometimes it can be more compelling, more moving, more physically and emotionally stirring than lived-life itself” (p. 129). Stories allow one to transcend the limits of time, space, and person and can offer one a glimpse of what lies beyond one’s understanding. Stories help us to make sense of our human lives (Geelan, 2007; Hutchinson, 1999; Laslett, 1999; Mattingly, 1991; Witherell & Noddings, 1991).

Sharing stories allows humans to relate to one another on a more complex level. While story offers a chance to learn about the other, it also provides an opportunity for
individuals to discover more about themselves. “A life as led is inseparable from a life as told . . . a life is not ‘how it was’ but how it is interpreted” (Bruner, 2004, p. 708). A story allows the reader time for reflection, contemplation, and alternative possibilities as he integrates the stories into his personal life narrative (Mattingly, 1991).

Stories not only provide an avenue for one to understand various characters within the story, but they also offer a glimpse into the life of the storyteller herself and give insight into her thoughts, feelings, and motivations (Chase, 2005; Doty, 1975; Duff & Bell, 2002; Jehangir, 2010). Stories often give individuals the courage to speak; they can allow for the silenced to be heard (Greene, 1991). As stories are passed from one to another, they become a collection of everyone who has told the story along the way. A story told is not stagnant; it morphs and changes along with those involved in its retelling (Duff & Bell, 2002; Polkinghorne, 1988).

Being involved in a story as the reader, the teller, or the author connects one to his own imagination. Through this connection, a person can perceive possible pasts, presents, and futures. One can experience life through more than just the use of the five senses. A person can re-imagine his world and thereby construct an alternate reality (Hillman, 1975).

While the terms story and narrative are similar, some suggest that there are differences between the two terms (Hatch & Wisniewski, 1995; Wiggins, 1975). Lyons and LaBoskey (2002) proposed that narrative differs from story in that narrative is “a means to capture the situatedness, the context, and the complexities of human action in teaching and learning” (p. 3). Stories are a particular type of narrative with a beginning, a conflict to overcome, and an ending (Egan, 1986). Novak (1975) implied that
storytelling comes before thinking, that storytelling is thinking without the constraints of external world as we know it and our internal motivation. In this way, story is a “more dangerous form of talk” (Mattingly, 1991, p. 244) because it is less controlled and it often includes the emotions and motivations of the individuals involved. Polkinghorne (1995) wrote that the term narrative carries with it a connotation of seriousness. In this research, narrative is the structure that encompasses stories.

Narrative

This research was presented as a class narrative, made up of a collection of stories that come from the students in this class. Casey (1995) submitted that an important focus in narrative research is the focus on self. There are multiple ways this research has focused on self: the students of the class were asked to reflect on their personal experiences as they relate to the understandings, memories, and dreams about science in their lives. As the researcher, my personal narrative was influenced by the stories of the class. Therefore, in addition to the classroom narrative that was presented in this research, my personal narrative related to science education, my currere, was presented as well.

Another way that self plays a part in this narrative is in the narrative of the reader. Throughout the experience of reading this research, the reader is encouraged to examine his own experiences with science, to consider engaging in his own currere. This interplay between the experiences of those written about in this research and the experiences the reader adds another dimension to this narrative and, in effect, is what provides the movement or flow in currere.
Geelan (2007) suggested that “the tales told should echo back into the lives of teachers and students in classrooms – and into our own lives and practices – and change them” (p. 8). This interplay makes the narrative meaningful. Several fundamental understandings are integral to meaning of narrative: time, action, situatedness, voice, and reflexivity (Clandinin & Connelly, 1998; Denzin, 1989; Richmond, 2002; Xu, Connelly, He, & Phillion, 2007).

**Time.** Narrative is influenced and often structured by time. Situations, while recounted in a single sitting, have occurred over a period of time. This passage of time allows for the narrator to consider internal and external influences on the narrative (Hutchinson, 1999). Some events, thoughts, and feelings may be forgotten or removed. The time elapsed allows for reflection and understanding, as well as for questioning and consideration. Time influences both the telling and retelling of the stories that make up the narrative and the experience of sharing the narrative influences the future, both of the storyteller and the listener (Clandinin & Connelly, 1991, 2000; Polkinghorne, 1988; Xu et al., 2007).

In this research, the class was asked to consider their relationship with science through time. Past experiences were therefore influenced by the time that has elapsed since the actual occurrence. Even the class’ descriptions of present experiences of science were affected by the time that elapses between focus group interviews.

**Action.** Actions that occur within the narrative are part of a larger reality. Separating particular actions from the reality in which they exist causes their significance to change. Yet this is how narrative develops as a life story. Life is never static; it is
never free from the influence of other factors. In this way, narrative represents the way a life is experienced (Polkinghorne, 1998; Xu et al., 2007).

My observations of the class in the science classroom allowed for the actions of the class to be understood. The class situations provided a context for the actions that occur. Similarly, the actions provided a window to the larger world of the class which occurs outside the science classroom setting.

**Situatedness.** Narratives are situated on multiple levels. The participant’s experiences transpired in a specific place, time, and manner under certain influences. Each participant in the narrative retelling brings to the narrative a unique past and present, and imagines a distinct future. The reader or listener is situated within his own reality; therefore, each reader will have a unique interpretation of the narrative based on his own situation (Clandinin & Connelly, 2000; Xu et al., 2007).

**Voice.** As oral histories were passed down through generations, each storyteller contributed his unique interpretation of the tale. So too do the voices of the individuals involved in a narrative impact the telling of this story. Each individual involved in this story brings her own self to the story (Hutchinson, 1999). Graves (1994) described voice as the “imprint of the [author’s voice] on [the author’s] writing” (p. 81). Without voice, stories become just words on a page (Graves, 1994). The voices in this story are not one voice but are the collection of the voices of the many individuals through which this narrative has passed (Chase, 2005).

Yet, in order for voice to be evident, it has to be heard. By bringing forward the voice of the middle school classroom, it allowed a larger audience to hear this voice.
Brooker and Macdonald (1999) suggested that, “most often in curriculum-making practices in Western schools student voices have generally been marginalized” (p. 83).

On the other hand, teachers concerned with voice usually take on the serious and significant task of eliciting and presenting the experiences and views of groups on the margins, thereby helping them to move from silence and invisibility to influence and visibility. (Rudduck & Flutter, 2004, p. 152, italics in original)

**Reflexivity.** The process of narrative is strongly influenced by the concept of reflexivity. Narrative is not just a retelling and imagining of events; it is the experiencing of these situations from a thoughtful perspective. The teller has had time to consider the past, present, and future from multiple angles. The reader is also involved in the narrative as he considers the narrative through his own lens (Clandinin & Connelly, 1991).

This research required many to involve themselves in being reflexive. Through the interview process, the class was asked to be reflexive when considering its relationship with science. In addition, I, as the researcher, was involved in reflexivity prior to this research, as I thought back on my own relationship with science; during the research as I worked to separate the stories of the class from my own stories of interacting with the class; and during the writing, as I reported the class’ connection with science, in addition, finding my new influenced relationship with science. As the reader reads through this research, she is also encouraged to also engage in reflexivity to uncover her own experiences and feelings about science.

**The Researcher’s Narrative: My Regressive Science Story**

When I began to be involved in this research, I realized rather quickly that in order to engage the class in currere I myself would have to experience currere.
Therefore, this research also represented my personal journey through *currere*. This should not be surprising. *Currere* is the personal narrative, the multitude of multi-layered experiences of the individual with the world around her. All aspects of this research, therefore, became part of my personal experiences of science.

I decided to present my literature review within my experience of the regressive, my past involvement of science, and my progressive, my dreams for my future relationship with science. This allows the reader to gain an understanding of both *currere* and my experience of science within the larger world. By sharing my narrative I not only provided the reader with access to the lens through which I came to be involved in this research, and through which I experienced this research, but I also encourage the reader to involve himself in his own narrative. As suggested by Rosenblatt (1978),

> the reading of a text is an event occurring at a particular time in a particular environment at a particular moment in the life history of the reader. The transaction will involve not only the past experience but also the present state and the present interests or preoccupations of the reader. (p. 20)

Therefore, the very act of reading this research would encourage the reader to come to his own understanding of the place of science in his life.

My personal narrative and the following research share the story of my growth, not only through my doctoral program, but through some of my understandings of science and experiences with science education, which bring me to the place where I am today. I began my doctoral program in education about 15 years after completing my master’s degree. I am a lover of school and after not having been the student in a classroom for some time, I felt comfortable to be back in that student role again. Very quickly after beginning my doctoral classes, I set aside any ideas for where I thought I
might be at the end of my program and allowed myself to fully experience the learning of a doctoral program. I was comfortable being a student and I was excited to be a student in this new era of electronic access. During my prior experiences as a university student computers were in their infancy and the internet as a public format did not exist. There were no swipe cards, no cell phones, no instant messages. When I had previously been a full time student, hard copies were the only types of copies that existed. I had to stand in line to register for classes and the cafeteria offered only one entrée per meal. Now, sitting in my pajamas at home, I could click on an article and instantly access the information from across the world. This new medium was fun and exciting for me as a student, and more importantly, it was another opportunity to learn, one which I truly savored (Rodriguez & Nash, 2004).

For the first few semesters of my doctoral program I purposefully did not concern myself with thinking about ideas for my dissertation research. I did not want to find the topic; I wanted the topic to find me. I did not want to limit my search to ideas that had been with me when I came into the program. I had heard many stories about people who start their doctoral program with their dissertation half written. Yet I believed that deciding a dissertation topic prior to beginning my coursework would limit the scope of my research. I wanted to be involved in something that would take me on a new path. While there were some ideas I entertained at the onset, I trusted that I would know when I had found the right topic for my research.

I do not regret letting my topic find me even though it made the research process somewhat longer. By allowing myself to explore new knowledges and integrate these with the understandings I brought with me to the doctoral program, I found out a great
deal about myself, about education, and about my understanding of science. This dissertation narrative begins with my past story, my looking at my prior science experience. This looking at the past, on my thoughts and feelings then as I now perceive them is also integral to understanding the concept of currere (Pinar & Grumet, 1976, p. 19).

My elementary school story. As an elementary school student in the 1970s, I grew up in an era of change and uncertainty. Yet it was also an age during which possibilities, especially possibilities for women, would begin to increase exponentially. Women began to gain more power politically, from work on the Equal Rights Amendment to the legalization of abortion, and social gender norms began to change (Arrow, 2007; Meyer & Whittier, 1994). Beginning in the 1970s women’s attitudes and attitudes towards women became more liberal (Twenge, 1997). As barriers against women in school and the work force began to recede, young women were encouraged to pursue any type of career (Novack & Novack, 1996). The popular culture image of the independent woman in shows like That Girl (Denoff, Persky, Thomas, & Thomas, 1966) and Mary Tyler Moore (Brooks & Burns, 1970) influenced my thinking about what it meant to be female. The shift in societal attitudes toward women would influence my schooling, my learning, and my choice of college major (Mason & Lu, 1988).

In elementary school I was considered to be a good student. This meant that I followed the rules and did what people told me to do (Leafgren, 2008). Rather than learning how to decipher, understand, and become independent, I was rewarded for being quiet, memorizing the answers, and doing what the teacher told me to do (Goodlad, 1984; Pope, 2001; Tobias, 1990; Wildy & Wallace, 2004). Kincheloe (1998) suggested that
what “schools have defined as intelligence consists of uncritically committing to memory an external body of information” (p. 135). I know that being a good rule follower helped me to get good grades in elementary and secondary school; I now believe that being a good rule follower and gravitating toward structure is what attracted me to become interested in studying disciplines of mathematics and science.

When I was young, I learned a science and mathematics in which there was most often only one way of doing things and one correct answer, the answer the teacher wanted (Larson, 1995; Pope, 2001; Tobias, 1990; Wildy & Wallace, 2004). The science and mathematics I learned was taught from textbooks and worksheets. The teachers asked the questions and the students answered. This type of science teaching reflects the content-oriented science that was prevalent during the early and mid-20th century, a science which was teacher-centered and dependent upon students’ listening and memorization skills (Larson, 1995; Lazarowitz, 2007; Pope, 2001). Although we did occasionally do classroom science activities (which were referred to as labs), the activities in which we engaged, as well as the answers which were expected, were prescribed by the textbook. For the most part these activities had one correct answer, which we students were to find through experimentation. Because this science was based on finding the correct answer, students often engaged in fudging the data in order to get the answer for which the teacher was looking (Aikenhead, 2006; Allen, 2008; Fairbrother & Hackling, 1997; Larson, 1995).

My early schooling followed the post-Sputnik emphasis on science and mathematics education in this country. The Cold War and the Soviet Union’s launch of Sputnik in 1957 propelled science and mathematics education into the forefront as a
matter of national security. In order for the United States to maintain a position as world leader and keep its citizens safe from communism, in order to win the Space Race, the mathematics and science taught in this country needed to be rigorous (Franklin & Johnson, 2008; Ladson-Billings & Brown, 2008; Lazarowitz, 2007; Pinar, 2008; Sanders, 2009; Seymour, 1992; Tolley, 2003; Welch, 1979). The 1958 National Defense Education Act supplied funding to increase the number of students in mathematics and science (Chelsa Roach of State Colleges and Universities, 2005). More students in these areas raised a call for better mathematics and science instruction, which led to increased federal funding for the National Science Foundation (NSF) and intense study about the best way to teach and learn science and mathematics (Hassard, 2005; Hurd, 2000; Welch, 1979). Science kits, rather than textbooks, were used in elementary classrooms and secondary students saw more open-ended laboratory inquiries. The United States won the space race by putting a man on the moon in 1969, and by the mid 1970s the emphasis on school science had dwindled. This so-called golden-age of science education was already in decline by 1976 when the NSF cut all funding for teacher education (Kubota, 1997).

My elementary education was also influenced by the Metric Conversation Act, which was passed by Congress in 1975 in an effort to keep the United States from becoming “an island in a metric sea” since most other countries in the world used the metric system of measurement (Woolley & Peters, 2011). The metric system was taught in schools, highway signs began to list distance in kilometers, and weather reports began to include the temperature in degrees Celsius (Kaw & Daniels, 1996). As a result of that movement, I now know the metric system quite well. I distinctly recall being drilled in
the workings of the metric system in second and third grade. In retrospect, I remember an emphasis and urgency toward our learning this new system of measurement, than I remember the metric system being used only occasionally and only in science class. It has always been an anathema to me why something would be considered so important one year and then disappeared from the curriculum a year later. I had learned science and mathematics as being factual and unchanging. Metric was something I had mastered and was eager to perform because I knew it well. How could it no longer be important?

My junior high school science story. While I went to a public school with a K-6 structure for elementary school, from fifth through eighth grades I attended a parochial school, one which was K-8. For each of those grades we had three teachers and the major subjects were split amongst them. I have no recollection of learning science in grades seven and eight. I know we must have done science and it would have been in the classroom (we didn’t have a dedicated science laboratory space), but I don’t remember learning anything specific. I can recall diagramming sentences, doing mathematics drills, and learning about the industrial revolution, but I do not remember anything about learning science during those years.

My high school science story. In the early 1980s when I was in high school, I was caught between a conventional past and a future of seemingly unlimited possibilities for women. The conventional dominated my high school experience: as a student at an all-girls parochial high school, I was on the academic track, but one in which the girls did not take calculus (although it was available to the boys in the boys’ school next door). By my senior year in high school in 1983, the girls’ school did have a computer, most likely a Tandy Corporation TRS 80, in a rather inaccessible back room. As college-track
students, I and my classmates were allowed to use it. The only thing we learned how to do through reading the manual was to program it to play a primitive game of poker. I do recall that having a computer at our school seemed to be important to parents and administrators, but I remember not understanding how to use the computer or for what it could be used.

Restricted course offerings in the areas of mathematics and science in high school can limit students’ opportunities to excel in these areas in college (Oakes, 1990, 1992; Seymour, 1992). In addition, Adelman (1998) and Trusty and Niles (2003) suggested that the intensity of one’s high school mathematics curricula had the greatest effect on likelihood to complete a bachelor’s degree. Trusty and Niles (2003) also determined that “the effect of early math ability on degree completion is almost completely mediated and dominated by math course-taking” (p. 106). Therefore, it is important for students’ post-secondary schooling that students have access to as many math classes as possible while in high school.

My high school science education was the traditional progression of biology, chemistry, and physics (Ewald, Hickman, Hickman, & Myers, 2005; Fensham, 2002; Hurd, 1983, 1991b; Lederman, 2001). The science I learned was still quite narrow within the disciplines, even though as early as 1970 the NSF suggested that science education be taught as more of an integrated subject (Hurd, 2000, 2002). While there has been exponential growth in the areas of science and technology since I was in high school in the 1980s, science as it was taught to me, is surprisingly similar to both the sequence and scope of material taught in my daughters’ high school in the 2010s. Aikenhead (2006)
suggested that the traditional science curriculum we encounter in schools today is “essentially a 19th-century curriculum in its educational intent and organization” (p. 14).

Looking back, I did not truly comprehend science in high school. At that time I was still a bit obsessed with and also encouraged to find the right answer for whatever problem I was solving (Allen, 2008, Fairbrother & Hackling, 1997; Larson, 2005). It seemed to me that there was always a correct answer which reflects the low-inquiry, teacher-directed type of lab activities – “cookbook” labs – I did in high school. Rather than offering an inquiry experience, these types of activities are merely confirmation activities in which the expected outcome is known in advance (Bell, Smetana & Binns, 2005; Gengarelly & Abrams, 2009; Harwood, 2003; Hofstein & Lunetta, 1982, 2004; Lazarowitz, 2007; McComas, 2005; Rigano & Ritchie, 1994, Roth & Barton, 2004).

While we were taught the scientific method, we were also taught a science that was black and white. It was most important to get the procedure right, answer the lab questions correctly, and come up with the right conclusion (Fairbrother & Hackling, 1997; Harwood, 2003). What actually happened didn’t seem to be very important (Costa, 1997). More important was that as a student, you were able to figure out ahead of time what the answer should be, and you were able to make the answer fit the problem (Allen, 2008; Costa, 1997; Del Carlo & Bodner, 2004; Fairbrother & Hackling, 1997; Rigano & Ritchie, 1994, 1995).

The science of science fair. I encountered the concept of authentic inquiry in high school when I attempted to complete two science fair projects on different occasions. One of my assignments in my science class (chemistry) during my junior year of high school was to do a science fair project. I was not particularly worried about this
project since most school assignments had always been relatively easy for me. In addition to that, I really enjoyed science and was starting to think about a college major in a science area. I believed that others expected me to win a ribbon and I myself expected this as well. As I contemplated a few project ideas, I remembered hearing somewhere that a cola drink would rot one’s teeth over time. I decided to test this. I obtained two human teeth from a family dentist and plopped them each in a glass of cola and waited. Looking back, I know that I had expected that the teeth would completely disintegrate in the month that they sat in the liquid. I started to get nervous when after a few weeks I hadn’t noticed any changes. I began to check the teeth each day, still believing that what I had heard couldn’t be wrong and still looking for a dramatic change.

I approached my science fair report and the construction of my tri-fold display board with trepidation. Because I did not see any noticeable change in the teeth, I believed that my experiment failed. Therefore, I believed I had nothing to write. Whenever I had done experiments in school, I had either gotten the answer for which I was looking or I would fudge the data on the lab report, copying data from someone who had got the expected result. I had no idea what a tooth might look like after it rotted from exposure to sugar, so I wasn’t even able to fudge the data. (Since I was in high school prior to the advent of the Internet and Google Images, I had few resources from which to work.) The science I had known to this point was black and white, either success or failure. The science I had learned had no other possibilities.

I don’t remember what I wrote for my science fair report, but I do remember being embarrassed by my commentary, my tri-fold board, and the fact that I didn’t get a winning ribbon. From my past experiences, experiments always had a correct answer, a
conclusion which supported the hypothesis. I didn’t value the data I collected as being worthwhile. My experience of the purpose of practical science was that it was “following the instructions” or “getting the right answer” (Hofstein & Lunetta, 2004, p. 38). Since I hadn’t had predetermined instructions, I felt that I must have done something wrong that had caused my experiment to fail (Allen, 2008; Del Carlo, Mazzaro, & Page, 2006; Fairbrother & Hackling, 1997).

“Too smart to be a teacher”. While in high school I was encouraged by teachers and guidance counselors to pursue a career in engineering. I was told by guidance counselors that I was too smart to be a teacher, and I was actively discouraged from pursuing even mathematics teaching or science teaching (Whatley, 1998, Willard-Holt, 2008). Although I didn’t know what engineering was, it sounded like it fit with the smart, serious, good girl persona I had followed all my life (Adelman, 1998; Barton 1998; Seymour & Hewitt, 1997). Looking back, I see that the decision to pursue science as a career was one that was based more on perceived prestige and influence, rather than on interest or aptitude (Roth & Barton, 2004).

Willard-Holt (2008) suggested that gifted students, both male and female, are most often encouraged to pursue high prestige careers. Teaching is considered by some to be a lesser career, in part because it does not require as much education as high prestige careers such as law, medicine, or engineering. As a result of burgeoning opportunities for women in the workforce during the 1970s and 1980s, younger women were often encouraged to pursue careers that had previously been limited to them by virtue of their gender (Whatley, 1998).
Although I perceived myself as having worked hard throughout my pre-college years, I now realize I hadn’t learned how to think or critically analyze much of anything. Handelsman, Miller, and Pfund (2006) suggested that “traditional, competitive, fact-oriented classroom does not promote deep learning for many people” (p. 30). I was very good at reading the words and answering the questions. I could anticipate appropriate answers, and I knew how to use the context clues. I knew that getting the right answer was good; it encouraged praise and high grades from teachers (Pope, 2001). I thrived in this atmosphere, this competitive nature of science (Seymour & Hewitt, 1997). Yet, this experience did not prepare me for the educational experience I would face in college.

**My undergraduate school story.** I began my undergraduate career as an engineering major at a mid-sized institution with a nationally recognized program in the field that I chose. I was now in co-educational classes with 300+ students and professors who most often practiced “silent teaching”: the practice of writing on the board while keeping one’s back to the class and rarely interacting with those in the classroom (Bailey, Scantelbury, & Johnson, 1999; Seymour & Hewitt, 1997; Springer, Stanne, & Donovan, 1999). I was at a loss. I had no idea how to learn, how to ask questions, or how to ask for help. I continued to judge my academic success solely on the grade I received. I became frustrated academically, while my GPA hovered around a 2.0 or a C average. This was an extreme disappointment for me since I continued to define myself by my academic success. This perceived academic failure led to my crumbling self-confidence. In my mind, I was failing and I had no idea what to do, nor any tools with which to fix the problems.
I distinctly remember the semester I left engineering as a major. It was during my sophomore year, the second semester of organic chemistry. The professor of the class had a notorious reputation for failing people. This was not the first “weed-out” class I had taken but it was one that was viewed by many students at my university as a major hurdle to success (Seymour & Hewitt, 1997; Tobias, 1990; Walden & Foor, 2008). I promised myself that I would work diligently to prepare for the first test. If I received a grade of C or better, I would stay in engineering; if not, I would take that as my sign to leave the major. Seymour and Hewitt (1997) suggested that “in the face of poor early test grades, freshman fall back on the same strategies for getting good grades that they learned in high school: they try harder, they cram, then try to work out what the teacher ‘really wants to know’” (p. 112). I continued to use the same poor academic strategies to prepare for this exam.

The professor gave the first test late into the semester, so that the day he returned it to us was the last day students were able to drop classes (so that it would appear on transcripts as a ‘withdrawal’ rather than a ‘failure’). Many in the class showed up that day with drop forms in hand, expecting the inevitable. The class average on the test was somewhere in the low thirties, while a failing grade was in the high thirties. I believe I scored somewhere in the D range, but I waited in line with many other students to get my drop form signed. Even after 25 years, I can still put myself in that class room holding my drop slip and waiting to receive the grade which I felt would determine my academic fate. I remember that following the test dispersal a large number of students, most likely more than half the class, lined up to have their drop slips signed. There was strength in numbers; I remember feeling somewhat comforted because obviously many others had
struggled in the same way that I had. I remember the distinct feeling of a weight having been lifted from my shoulders, as I felt that this was proof that I should not major in engineering. But I also remember feeling like a failure.

Trumbull (1990) described courses such as this where “test design and grading often seemed to be arbitrary and sometimes even malicious” (p 166). It seemed that everything about the course, from the reputation of the professor, to the style of teaching, to the tests, to the grading was designed to “psych out” the students (Tobias, 1990; Trumbull, 1990). Seymour (1992) suggested that students switch out of STEM majors more often for reasons “cultural or structural” and less often for reasons of “personal inadequacy” (p. 234). Seymour (1992) cited unapproachable faculty, poor teaching, and lack of engagement with faculty members as contributing to this exodus from the academic major. In this situation my withdrawal from the class had little, if anything, to do with the course content and more to do with a prevailing ideal of survival of the fittest.

While some of the details of this experience are hazy, I do recall the emotions that went along with it. I remember the dread of looking at a test and truly not having any idea of where to begin. I remember trying to keep up, but knowing I was falling farther behind. I remember feeling as if I had failed, for getting Cs in my classes. “When my wants, needs, and beliefs were in contrast with either school or science, then it was my ideas that were somehow faulty” (Barton, 1998a, p. 23). In my mind it was not the teacher, the curriculum, or the pedagogy, it was I who was deficient in science.

College undergraduates leaving majors in engineering and the sciences was not and still is not an unusual phenomenon. Science educators refer to a science education “pipeline” which represents the path of movement of students through science classes
from as early as middle school up to those classes that lead to a post-graduate degree. Most often discussed is the leakage in this pipeline (Blickenstaff, 2005; Lee, 1998; Oakes, 1990b; Sanders, 2008/2009; Seymour, 1992; Tyson, Lee, Borman, & Hanson 2007). During the time when I left engineering in the mid 1980s various national studies estimated the percentage of enrolled students leaving engineering, science, or mathematics as a major to be as high as 50% (Seymour, 1992; Seymour & Hewitt, 1997). Students left these majors in much higher rates than switched to any of these majors, thus resulting in a net loss. In addition, the number of U.S. students who completed their undergraduate career in a mathematics, science, or engineering major and continued on for an advanced degree began to fall sharply at this time; the balance being made up of foreign students (Seymour, 1992; Seymour & Hewitt, 1997).

This exodus of undergraduate majors in STEM fields continues today for many of the same reasons that existed 25 years ago. Seymour (2002) reported that major complaints of STEM undergraduate students, both from those who stayed and those who left the majors, were the lack of instructor pedagogy and the inability to get academic help. Gender stereotypes continue to exist, particularly in the areas of mathematics and science, which disengage women from the content area (Correll, 2001; Ridgeway & Correll, 2004). Both women and individuals with minority backgrounds continue to drop out of STEM majors at a higher rate and are underrepresented in STEM fields (Blickenstaff, 2005; Cheryan & Plaut, 2010; Griffith, 2010; Jacobs & Simpkins, 2005; Seymour, 1992, 2002; Steele, James, & Barnett, 2002; Young, 2005). This underrepresentation leads to a lack of women and minorities in STEM faculty positions.
and in management, which in turn leads to a lack of role models for women and minorities interested in these areas (Moses, Howe, & Niesz, 1999; Oakes, 1990).

My undergraduate story is important for me to revisit because it signified the time when I believed I could no longer do science. I had gone from being one of the smart kids to being what I felt was a failure. Something I loved and enjoyed had permutated into something I could no longer do. Since I felt that I was no longer one of the smart students, I had no idea who I was. “The loss of Self due to modeling and the disturbance of fantasy life are two regrettable and common consequences of one’s schooling” (Pinar & Grumet, 1976, p. 12). This loss of Self played an integral role with not only my education but also my confidence and self-esteem.

**School science.** It has most often been the focus of school science to prepare students for their next level of science (Aikenhead, 2006; Fensham, 1993; Hurd, 2000, 1991a; Roth & Barton 2004; Smith, 2010). Fensham (1999) remarked that before the 1960s only “serious students” who intended further study in science were offered science classes (p. 756). The pathway through school science is often referred to as the pipeline. The pipeline that leads through school science has typically held onto those who are well-versed in school science, while releasing most students who do not have aptitude in science or science as a career goal (Adamuti-Tache& Andres, 2008; Blickenstaff, 2005; Fifolt & Searby, 2010; Metcalf, 2010; National Academy of Science 2005, 2010).

Many students are not welcome into the study of science. Throughout the history of teaching science in school, science study has often been exclusionary and selective by race, gender, and ethnicity. Barton and Yang (2000) refer to the “culture of power” which surrounds science, traditionally maintaining science as a field for white males (p.
The Western nature of the science, which tends to emphasize man’s power over nature and which is typically taught in the United States, can exclude those who come from different cultural and philosophical backgrounds (Aikenhead, 2006). Students’ family background, traditions, and customs can be at odds with the type of behavior expected in the science classroom (Fradd & Lee, 1999; Rodriguez, 1998). The economic background of students can also prevent those students from participating fully in a science that involves the understandings of a middle class background (Barton, 1998b).

What science should be taught in school and how to teach science in school is a topic that continues to be debated. Osborne, Collins, Ratcliffe, Millar, & Duschl (2003) stated science courses have been adapted from curricula whose roots lie in programs essentially conceived as foundational studies for those who were to become the next generation of scientists (p. 693). Other types of science teaching include school science that is focused on the science that is needed for everyday life and the science that is needed to understand science presented in the world.

While science typically values discovery, school science tends to be taught in a positivistic manner, where students are initiated into the culture of science in which the science is perceived to be fact-based (Newton, Driver, & Osborne, 1999). School science tends to be fact-based science, with experimentation used to corroborate rather than for problem-solving. The process of the scientific method still continues to dominate all areas of science education (Jenkins, 2007).

Over the past 40 years the science education community has looked critically at science teaching and has focused on other aspects of the science classroom. The concept of constructivism has encouraged science education researchers to search to understand
how students make sense of the knowledge in the science classroom. Attitudes, behaviors, and classroom activities of both science teachers and students have been seen as important to the understanding of how science knowledge is constructed (Hofstein & Lunetta, 2004). The term inquiry has come to play an important role in science education, and discussion continues about the meaning of that term and what inquiry looks like in a science classroom (Hurd, 2002).

An assumption is that when students interact with problems that they perceive to be meaningful and connected to their experiences, and when teachers are guided by what we know about learning, the students can begin to develop more scientific concepts in dialogue with peer investigators. (Hofstein & Lunetta, 2004, p. 32)

**My journey into teaching.** I would eventually graduate from undergraduate school with a major in German and a minor in economics, far away from the engineering major with which I started. I went directly to graduate school to pursue a master’s degree in German, in large part because I would spend my first year studying in Austria, and I wanted to know the language well. In my last semester of graduate school, I was asked to be a teaching assistant. I was not especially excited about this assignment, but I prepared for it nonetheless. I entered my first day of class, extremely nervous and unsure. Once I began to interact with the students, sharing my knowledge with them and observing them learn things that they hadn’t known prior to our classtime, I began to feel an indescribable exhilaration. By the end of my first 45-minute lesson as a teacher, I knew that I had found my calling.

Following my master’s degree program, I taught night classes in German as an adjunct instructor, while working a variety of day jobs in nonprofit management. Working in a nonprofit agency allowed me to do some of the things a teacher does – I
engaged in public speaking, I gave tours, I trained volunteers – but it was not teaching. I looked toward the future seeking a way to return to the classroom.

Over the next 10 years I would marry and have children and hold several positions with non-profit organizations as my family moved several times for my husband’s career. I was able to do some adjunct work and informal teaching but in order to be a K-12 teacher, I would need to get teacher licensure. Until my family and financial situation allowed me to go back to school, I would work on exploring my relationship with science.

**Going back to science.** Since the time I had left engineering as a major I continued to be interested in science. Because my spouse completed his doctoral work in biology and worked as a biology professor, I continued to be surrounded by people engaged in science activities. Even among friends and family involved in science, though, I continued to feel like an outsider. Barton (1998a) discussed the tradition of elitism in science and its ability to make people who are not part of the elite feel like outsiders – not good enough or smart enough to succeed in science.

Over several years, as I talked to professors and students of science, I began to question my experience with science and my feelings of inferiority in relation to science. I began to realize that I was interested in science and that maybe the problems I experienced with science education were more related to the structure of science education rather than to my inabilities or perceived inadequacies. Barton (1998a) described the traditional arrangement of relationships in science as a series of dichotomies: “insider/outsider, scientist/nonscientist, teacher/student, self/other” (p. 108). To this list of dichotomies, I would also add “community/individual”. When I left the
community of science, I was left alone to decipher what had happened. It wasn’t until I commenced my doctoral program that I gained any understanding that my relationship with science was far from unique.

While I continued to feel outside the science community, I also started to believe that perhaps there was a place for me in science. I sensed that there were others like me who had felt excluded from the community of science. I cannot name what I felt at the time, but I envisioned a place in science that included not only me, but the others who felt inferior to science as well.

When the time came that I was able to return to school for teacher licensure, I decided to pursue licensure in secondary (grades 7-12) science. Although at the time I would not have been able to verbalize how I came to my decision to return to science, I knew in my heart that I was making the right decision. I knew that I really enjoyed science. I knew that I did not want future students to have similar experiences to mine. I did not want students to feel that they could not do science or that they were not wanted in science. Somehow I wanted to blur the boundary between those on the inside of science and those on the outside.

Science literacy. Over the past 75 years there has been much research into science education related to the questions about who should learn science, what science should they learn and why should science be taught (Yager, 1983). Since the 1960s there has been an increased emphasis on ideas such as science for all, citizen science, and science literacy (Carter, 1991; Hurd, 1991a; Osborne & Collins, 2001). There is some agreement that individuals in today’s society should have a basic understanding of science, yet exactly what is that understanding of science continues to be debated (Bybee
& Van Scotter, 2007, Fensham, 1999, 2002; Hurd, 1991b). As science excludes individuals so too do individuals often regard science as “uncertain, contentious, and often unable to answer many important questions with the required degree of confidence” (Jenkins, 1999, p. 704). Impey, Buxner, Antonellis, Johnson, and King (2011) described the concept of science literacy as “a foundational understanding of how scientific knowledge is gained, how the scientific enterprise proceeds, and how to distinguish scientific facts from other kinds of information” (p. 32).

While many agree that a basic knowledge of science in the general population might be worthwhile toward helping individuals in this age of increasing technology, there is an understanding that science literacy is not an all or nothing proposition; there are varying levels of science literacy. But just who determines what it means to be scientifically literate and what knowledge is needed in order to be scientifically literate is also debated (Bybee, 1987; Fensham, 2002; Jenkins, 1997). Weinstein (2010) argued that the “scientific literate is ultimately in a position of extreme dependence and obeisance to the scientific professional class” (p. 268), while Roth and Barton (2004) posited “scientific literacy currently means to question nature in ways that do not, reflexively, also question science and scientists” (p. 3).

Hurd (2002) explained that in 1970, the NSF suggested that school science curriculum should relate to “society and personal development” (p. 3). This version of science education came to be referred to at STS or Science-Technology-Society (Zembylas, 2005). The basis of this type of science was providing individuals with science. Fensham (2002) described some topics that could fall under the realm of science literacy:
• “Home and workplace safety
• Medical health and hygiene
• Nutrition and dietary habits
• Selection and proper use of consumer products (consumer wisdom)
• Leisure and entertainment” (p. 19).

This version of science literacy puts the citizen and the citizen’s everyday needs as priority rather than the primacy in science education being the growth and future of scientific enterprise (Bybee, 1991; Fensham, 2002).

Another version of scientific literacy has to do with an understanding of science as it is presented in the media. This sort of scientific literacy becomes relevant as society becomes more connected through cell phones, the internet, and satellite capability. Fensham (2002) reported that the Science Expert Group for PISA (Programme for International Student Assessment) suggests that a scientifically literate individual be able to address “scientific questions that one finds in the media; critically looking at and summarizing evidence produced, evaluating results, and problem solving” (p. 200).

Roth and Barton (2004) suggested that “despite the nearly 50-year history of ‘science literacy’, science educators have not been able to arrive at a precise or agreed-upon definition” (p. 22). Feinstein (2011) argued that we should “examine how people actually use science in daily life” in an effort to encourage “new ideas of science literacy that are genuinely useful to our students and our society” (p. 170). Roth and Barton (2004) continued this conversation, naming science literacy “citizen science” and suggesting that it “is related to a variety of contexts, ranging from personal matters…, livelihood, . . . leisure . . . to activism and organized protest” (p. 159). Holden (2010)
remarked that science literacy “is sometimes used interchangeably with science information literacy or information literacy in science disciplines” (p. 267-268). Hand et al. (2003) reported that “we need to ensure that language practices are embedded in authentic science inquiry to construct meaningful understanding as well as to develop language strategies and understanding of scientific discourse (p. 614). The scope of topics included in the discussion about scientific literacy can change depending on who is involved in the conversation.

Inherent in the possibility of a citizenry who is scientifically literate are students who are working toward becoming scientifically literate. Yet “students are not viewed as both producers and consumers of science” (Zembylas, 2005, p. 711, italics in the original). That is, even though there is an expectation of scientific literacy, a dichotomy between scientists and the general public continues to exist. Aikenhead (2006) advised that this type of science “nurtures, at the very least, the development of a critical stance toward science and technology” (p. 6). Roth and Barton (2004) suggested that “scientific literacy cannot be prepackaged in books or delivered to students away from the lived-in world. It must be understood as community practice, undergirded by a collective responsibility and a social consciousness with respect to the issues that threaten our planet” (p. 3).

**My science teaching experience.** When I began my middle school science teaching career, I planned to teach like I had been taught. But having been a student in a classroom for almost 20 years, I also came to realize how I as a student liked to be taught and how I didn’t like to be taught. Although I couldn’t verbalize it, I knew that there was something wrong with a classroom where a teacher walked in, wrote on the board for 45
minutes, and then left the room, allowing himself no time for interaction with the students or the material. I believed that education is more than “the exchange and acquisition of information” (Pinar, 2004, p. 8) and that knowledge is more than “simply an external body of information independent of human beings” (Kincheloe, 1998, p. 135). I had experienced classes where I felt I truly learned something that would remain long after I left the classroom. I had come to understand that true learning was not equivalent to getting an “A” or 100%.

When I began to plan for my first teaching experience in a junior high science classroom is the first time that I remember ever wondering about the concept of curriculum. At this first venture into K-12 teaching, my understanding was that the curriculum was the information that was taught to the students (Klein, 1989). I understood the curriculum to be driven by the standards, be they state or national standards. In essence, the curriculum I experienced was driven by and determined by an other – some entity with much more knowledge than I, an entity who knew far better than I what students in early adolescence should know about science (Gehrke et al., 1992). Egan (1999) described these others as the stakeholders: the parents, government, businesses, and public, who “are assumed to have a right of influence on the school curriculum” (p. 93). Many who write curriculum are from within the school setting and are concerned with “the perceived realities of classrooms and school settings of school practice” (Pinar, 1978, p. 122). In my situation the science curriculum of my classroom was influenced locally by a diocesan committee; but in other cases the curriculum might be influenced by a school board, a curriculum director, a textbook company, or a state textbook adoption committee (Gehrke et al., 1992; Pinar et al., 1995). The curriculum
was merely something I followed. At the time I didn’t realize that by following the curriculum I was handed, I was acquiescing to the exiting power structure (Ginsburg, Kamat, Raghu, & Weaver, 1995).

*The Text.* The textbook available to me in my classroom defined the content, that information I was to teach to the students. I was the only junior high school science teacher at my school, and while I had the official graded course of study, the classroom textbook originally defined what I taught, how I taught, and when I taught this information to my students. The textbook is usually chosen to maintain the content and works in its own way to influence what is taught in the classroom (Klein, 1989). The text allows teachers to encourage the values and mores of a larger society rather than being true to their own, individual values (Purpel, 1991). Apple (1988) suggested that most of what is taught in schools is defined, not by the course of study, but by the information available in the textbook. The textbook chosen for a class reinforces the importance of specific information and the unimportance of other information based on what information is or is not contained in the text (Sizer, 1999).

Kuhn (1962/1996) referred to science textbooks, in particular, as “the source of authority.” He suggested that textbooks work toward the “perpetuation of normal science”; science textbooks refer to the history of scientific discoveries in a linear fashion, thus hiding “a process that lies at the heart of the most significant episodes of scientific development” (p. 140). In short, textbooks take away the messiness of scientific discovery, thus perpetuating “the pattern of historical mistakes that misleads both students and laymen about the nature of the scientific enterprise” (p. 142).
The choice of the text also reaffirms the beliefs of the community that chose the text. The content, in this way, functions as “the list of data and rudimentary disciplinary skills, and their mastery reflected by a test on that list, a test given immediately on the study of that list or quietly crammed for by students worried by the implications for them of low test scores” (Sizer, 1999, p. 164). Teachers are the inheritors of this status quo and are then expected to deal with issues inherent in the given curriculum (Purpel, 1991).

In the fall of 2009, nearly 49.8 million students attended public K-12 school with another 5.8 million students attending private schools (National Center for Education Statistics) but all schools are similar to each other, to the point of being interchangeable (Purpel, 1993). “Most American schools, however, still tend to be modeled after the assembly-line factory” (Pinar, 2004, p. 27). With a number of states having already bought into the idea of national education standards, schools will only become more similar. The use of specific texts works to contain and propagate central ideas of a specific content.

**Moving from content to curriculum.** Although I felt that, as a teacher, I didn’t have much voice in determining the curriculum, I soon realized that there were topics in my integrated science classroom toward which I gravitated, and some which I just didn’t like. There were topics which seemed to engage my students and topics which appeared to put them to sleep. Aikenhead (2006) suggested that “teachers construct their own meaning of any intended curriculum as they negotiate an orientation toward it and decide what to implement, if anything, in their classroom” (p. 62).

The longer I taught middle school science, the more I began to modify what I taught to my students. In a sense, and though I did not realize it at the time, I was
moving more toward my curriculum. There were topics, such as alternative energy and genetics, which I felt had particular relevance to my students, which seemed to engage my students, and which seemed to encourage the inquiry science I wanted to teach. These were topics with which I felt my students and I could engage together.

Cherryholmes (1987) suggested that curriculum is “a study of what is valued and given priority and what is devalued and excluded” (p. 297). I began to question my understanding of curriculum and how I believed curriculum should look in my classroom.

As my teaching career continued, I continued to cultivate this concept of curriculum – my curriculum. And although I had moved tentatively from the curriculum to my curriculum, I still felt a great tension and disconnect between these two. Purpel (1991) shared that the reason many teachers are burned out and tired is due to the frustration with the distance between what teachers are supposed to do and what teachers are actually doing in the classroom. While the curriculum was still overarching my teaching, behind the classroom door my curriculum infused the classroom. [Grumet (1989) defines “behind the classroom door” as “the privacy and intimacy that teachers establish with their students when they close that door, construction paper taped over the glass and get down to business” (p. 21).]

Although I still used the standards as my outline, my curriculum now included science topics about which I felt passionate and on these I placed more emphasis. There were also topics that, while still part of the official standards, seemed to be of little relevance or importance to both me and the students. Then there were topics that seemed to be most meaningful to my students. During discussion of such topics was when my students seemed most engaged: they talked in class – about the topic we were studying –
and they asked questions. They even talked about such topic in the hallway or shared with me conversations from home this topic we were covering.

There were days when I seemed not to follow the official curriculum at all; on these days, I followed my curriculum. It was during these days that I felt simultaneously guilty and exhilarated. These were days when I heard a great story on the radio on my way to school, and I knew I had to share it with my students because I found it to be interesting and relevant and it was science, even though the topic was not part of the official curriculum.

The longer I taught in the classroom and began to negotiate my own ideas about my curriculum, the more it began to make sense to me that the students played a role in this new understanding of curriculum as well. As I brought with me my knowledge, biases, understandings, and experiences to the classroom, so too did each of my students bring with him to my classroom his own knowledge, biases, understandings, and experiences. I began to see that “unless students are moved to incorporate school information into their own lives, schooling will remain merely an unengaging rite of passage into adulthood” (Kincheloe, 1998, p. 135). If my lived experiences played a part in the curriculum in my classroom, shouldn’t my students’ lived experiences also play a part in the curriculum of the classroom as well?

As teachers, we expect that students will come to us with some knowledge of what they have learned in the previous years. State and federal benchmarks and standards are based on students’ school knowledge of topics as they move through the system. But we often fail to recognize the knowledge of the world that students bring with them into their classrooms. Students do in fact bring with them to the classroom a
wealth of knowledge from their own experiences in the world as human beings (Provenzo, 1995). Perhaps my students’ personal experiences were just as important, maybe even more so, than my experiences or the official curriculum.

Nel Noddings (1997) suggested that “it has always been an anathema to democratic life for authority to impose its dictates on unwilling subjects” (p. 188). Students are the unwilling subjects in the current authority of curriculum. The widely-accepted understanding of curriculum, that information which is taught in the classroom, silences the voices of the students (Brooker & Macdonald, 1999).

My understanding of the importance of each student’s experience became more evident as we did the school science fair each year. I typically worked with students to help them develop a project that was something of interest to them, something to which they had access, and hopefully, something which they would consider relevant. I remember one particular student, Mia, who was struggling for a project idea. Somehow we stumbled upon the fact that Mia liked to make (and eat) pancakes. This interest eventually led her to an investigation of different pancake mixes, to discover which one made the ‘fluffiest’ (by her definition) pancakes. In addition to what I required for this project, Mia contacted several companies for information and talked to scientists to discuss her project and results, all the while stating that she couldn’t believe this was science because it was so much fun. While this student did not receive the top grades in this class, she won regional science fair awards for her project. For this student, this experiment was something that she lived and something which had meaning in her life. According to Freire (1970/2006), “Students, as they are increasingly posed with problems relating to themselves in the world and with the world, will feel increasingly challenged
and obliged to respond to that challenge” (p. 81). Mia followed her curriculum; she felt no pressure to determine the right answer, or what the teacher wanted, or even to follow directions that didn’t make sense. Mia was engaged in her personal curriculum.

In addition to engaging the students, projects such as these engaged me as a teacher. The students’ interest and excitement in these projects made science more exciting to me. I became more of a mentor to my students and their ideas and interests. It allowed me to stop trying to think of ways to keep them busy with the topic under study. Instead it gave me permission to be both teacher and student, alongside my students, who became both student and teacher. Freire (1970/2006) suggested that “education must begin with the solution of the teacher-student contradiction, by reconciling the poles of the contradiction so that both are simultaneously teachers and students” (p. 72, italics in original). My students began to teach me and others from their personal experience. Our individual classroom roles began to move from ones of teacher-student toward roles of colleagues, where each shared individual understandings and experiences. “The teacher is no longer merely the-one-who-teaches, but one who is himself taught in dialogue with the students, who in turn while being taught also teach. They become jointly responsible for the project in which all grow” (Freire, 1970/2006, p. 80).

**A new understanding of curriculum.** Britzman (1988) remarked that “teaching means being intellectually and emotionally open to that which one cannot foresee, predict, or control. . . . teaching means acknowledging and working with all of the uncertainties that are the sum of our lived lives”(p. 74). The uncertainty and discomfort I experienced with the official science curriculum I was given for the classroom forced me
to acknowledge a different understanding of curriculum. Cherryholmes (1987) suggested that “the norm for curriculum, then, is not consensus, stability, and agreement but conflict, instability, and disagreement because the process is one of construction followed by deconstruction by construction . . . of what students have an opportunity to learn” (p. 314).

Grumet (1989) suggested that “curriculum is not merely the syllabus. It is not only the reading list, schedule of interests, papers, and homework assignments. Curriculum is the way the world enters school” (p. 22). This idea of curriculum brought some clarity to my personal search. In this way curriculum is not a thing but a relationship between the world and school. Curriculum is no longer “owned by the front office” (Grumet, 1989, p. 23) or “located in the multinational textbook conglomerates, in state textbook adoption committees, in district or ministry curriculum guidelines” (Pinar et al., 1995, p. 860). Curriculum now involves a personal relationship that reflects one’s interaction with the world both inside and outside of school. If, as Sizer (1999) stated, curriculum is “ultimately what is structured in the child’s mind – that is, what is remembered, understood, used, and enjoyed - . . .” then my students’ relationships with the world inside and outside of school is what mattered most.

That is why curriculum is never the text, or the topic, never the method or the syllabus. Curriculum is the act of making sense of these things and that requires understanding the ways that they do and do not stand for our experience. (Grumet, 1995, pp. 19-20)

Student Voice

Research about student voice began to appear more frequently in education literature after 1990, although Rudduck and McIntyre (2007) suggested that interest in
Student voice began in the 1960s (Cook-Sather, 2006; Fielding, 2004, 2007). Student voice has been a more researched topic in England, Australia, and Canada; the United States has more recently entered the student voice discussion (Cook-Sather, 2009; Jenkins & Nelson, 2005; Rudduck & McIntyre, 2007). Flutter (2007) stated that “the basic premise of ‘pupil voice’ is that listening and responding to what pupils say about their experiences as learners can be a powerful tool in helping teachers to investigate and improve their own practice” (p. 344). Fielding (2004) suggested that “teachers, researchers, parents, and adults in general speak too readily and too presumptuously on behalf of young people whose perspective they often misunderstand and, in many contexts, frequently disregard” (p. 123).

Rudduck and McIntyre (2007) maintained that “what schools do for their pupils can be significantly enhanced through listening to pupil voices only if these voices influence what happens in classrooms” (p. 23). Listening to student voice can help teachers to know how students best learn (Flutter, 2007). Cook-Sather (2006) remarked that “young people have unique perspectives on learning, teaching, and schooling; . . . their insights warrant not only the attention but also the responses of adults; . . . they should be afforded opportunities to actively shape their education” (pp. 359-360). As stated by SooHoo (1993),

Somehow educators have forgotten the important connection between teachers and students. We listen to outside experts to inform us, and consequently, we overlook the treasure in our very own backyards: our students. Student perceptions are valuable to our practice because they are authentic sources; they personally experience our classrooms firsthand. (p. 386)

How student voice is heard and what is done with it is important (Cook-Sather, 2006). Student voices provide different perspectives on the classroom, the content, and
the relationships that exist between and among these. Thus, student voice “asks us to
canect the sound of students speaking not only with those students experiencing
meaningful, acknowledged presence, but also with their having the power to influence
analyses of, decisions about, and practices in schools” (Cook-Sather, 2006, p. 363).

DeFur and Korinek (2009) reported that

beneath the veneer of adolescence, students have a solid sense of what is both
effective and important to keep them engaged and successful in learning.
Listening to and dialoguing with all types of students – not just the high achievers
or natural leaders – and encouraging them to voice their opinions promotes
community, a sense of belonging, and increased student engagement. (p. 19)

Researchers suggested several advantages to using student voice in the classroom.

Bernhardt (2009) proposed student voice as a way of accessing a student’s
autobiographical voice to engage them in the subject matter. This also allows others to
understand the meaning behind the student voices. Cook-Sather (2006) suggested that
“another positive aspect of student voice work is that it acknowledges and argues for
students’ rights as active participants—as citizens—in school and beyond it” (p. 366).

Bergmark (2008) suggested that “giving voice to students is the cornerstone of character
education” (p. 267); it encourages students to care and respect themselves and each other
(Bernhardt, 2009; Mitra, 2008). Engaging in discussions in student voice requires that
individuals are actually listening to what the students have to say (DeFur & Korinek,
2009).

Trust is important in the relationship between the teacher and the student or the
administration and the student in order to foster authentic student voice (Cook-Sather,
2009; Rudduck & McIntyre, 2007). Many students experience powerlessness in the
school setting (Mitra & Gross, 2009; Pope, 2001). Fielding (2007) maintained that the
spaces in which students can share their voices are often managed by adults. Students having a voice in their school experience can shift the balance of power between the adults and the students, making the students more equal partners in the school setting (Cook-Sather, 2006; Mitra, 2004).

Students need to have safe and encouraging spaces where they can speak out about what is important to them (Bernhardt, 2009; Cook-Sather, 2006; Smyth, 2006a). Flutter (2007) advocated that pupils are more excited to add their voice to the conversation when they are asked for their help to make a lesson more engaging, not to critique a teachers’ performance or evaluate a particular lesson. Students also feel more open to voice when it becomes an ongoing activity, rather than a one-time opportunity.

Working with student voice can be a tricky proposition for teachers. It is important that all students have the opportunity to share their voices. All students must be made to feel that their voices will be heard, no matter what they are saying (Cook-Sather, 2006). Student voice has the power to “unlock the shackles of habit that so often bind teachers to their familiar routines of practice and thought” (p. 352). Including student voice in the conversation models respectful behavior and teaches students how to listen to others.

Working with student voice is not without difficulties. There is a danger of reducing the multitude of voices to a single, homogenous voice (Cook-Sather, 2006; Fielding 2007). Student voices may also be in conflict with school values or ideals. There is also a danger of using student voices as a form of control for an institution, using what students have to say against specific teachers or school (Cook-Sather, 2006). Mitra and Gross (2009) also offered that the poor quality of discussion and insincerity on the
part of the adults can lead to more problems than offer solutions. Criticism is that 
teacher’s voice can be silenced.

Involving the student voice in conversations about school can be an emancipator 
process for all involved (Fielding, 2007). Student voice can allow adults to hear what 
students are actually saying, positioning students as individuals of importance in the 
school setting. Adults listening to student voices can encourage students to feel that their 
opinion is valued. It can also help students to develop problem solving skills as they 
participate in active collaboration with adults (Mitra, 2004). Student voice efforts can 
therefore provide a fresh or new way of seeing problems that had previously been ignored 
or misunderstood (Mitra & Gross, 2009, p. 539). Rudduck and McIntyre (2007) 
remarked that teachers most appreciate hearing from students when the comments will 
help the teacher to become a better practitioner.

**Classroom Narrative**

School is a patchwork of relationships: between and among students, teachers, 
staff, and administration. In addition to these interpersonal relationships, there are also 
relationships within the classroom between the teacher and students and the content and 
instruction. Relationships also exist within and among individuals and the social 
structure of the classroom, the reality of the subject matter to the students, and each 
student’s lived experience brought with him to the school. Connelly and Clandinin 
(1990) suggested that narrative is a way for students to make meaning of this patchwork 
of school relationships. Thus, each student is more than just his educational record. Each 
individual brings with him to the classroom a personal, social and historical context
unique to himself, as well as a variety of relationships among these experiences. Untangling these classroom relationships and seeking their meaning is a difficult but necessary task, one which is integral to uncovering the *currere* of a middle school classroom.

By allowing the class stories to be the focus of a narrative, long-held assumptions and expectations about who has privilege in the classroom are challenged. The daily workings of a middle school classroom tend to be directed by the teacher, the textbook, the administration, and the content standards. Understanding the context of relationships in a classroom requires one to be aware of his own preconceived biases and embedded thinking about life in the classroom. Cook-Sather (2007) suggested that such biases are “particularly dangerous because they have become, by and large, unconscious. They act like a frame or filter, only letting in certain impressions” (p. 860).

Since narrative involves story and conversation, it offers an easy and accessible way for students to participate in research about their own experiences. Conversation allows students to share their stories while validating that the life stories of the students are worthwhile and important. Witherell and Noddings (1991) described that “the power of narrative and dialogue as contributors to reflective awareness in teachers and students is that they provide opportunities for deepened relations with others and serve as springboards for ethical actions” (p. 8). Being involved in narrative telling can help students learn more about themselves and their relationships. Student narrative can provide others with a unique insight into the lives and experience of students in a classroom.
**Narrative with students.** School-aged students currently spend their school days on the receiving end of decisions made for them, from what they are to learn in class to what will be served for lunch. Yet outside of the classroom students routinely deal with the world as it presents itself. By the time students enter school they have been surrounded by a world in which they have made decisions, developed relationships, weighed choices (Egan, 1986).

As a child moves from the door of his home, onto the bus and into the classroom, he is continuous and integrated; it all goes along with him and it all comes home again. If we are to understand the sense he makes of either world, we must accompany him on the journey. (Ginsberg et al., 1995, p. 65)

Children bring with them to school a life which they have constructed and in which many have thrived.

Mayall (1994) suggested that researchers should consider children moral interpreters of the worlds they engage with, capable of participating in shared decisions on important topics; as people responsible enough to be paid for their work, as discussants of moral values, as people with denied rights to social and physical space, indeed as participants in the division of labour at home and elsewhere. (p. 8)

Children are capable of making decisions and participating in discussion about their life, their hopes, and their experiences. Researchers play a large part in how society views children and childhood (Punch 2002). Cook-Sather (2006) reported that “tendency for educational research to be conducted on and not with students” (p. 372). “When the environment marginalizes by not providing for rich narrative experiences, then the meaning and identity that developing selves are making withers” (Hutchinson, 1999, p. 48). Rudduck and McIntyre (2007) related that “the more pupils are enabled to ask and to answer their own questions about teaching and learning, the more fully teachers will be
able to learn from the different perspectives that pupils can bring” (p. 41). Allowing children to participate wholly in research about themselves and their lives extends the idea that children are capable and their views are worthwhile.

**Middle School**

There are many different configurations for K-12 schools in the United States. Junior high schools began in the early 1910s as a way of separating adolescents from the younger students in the traditional K-8 school (Manning, 2000; Toepfer, 1962). They also prepared students to stay in school, since at this time many students dropped out by the eighth grade, and prepare students for either higher education or for vocational education (Beane, 1991; Hurd, 2000; Manning, 2000). The junior high school functioned as a high school for younger students with distinct subjects offered and little, if any, course integration.

Early adolescence is a term often used to describe students between 10 and 15 years of age. During these years students go through tremendous cognitive, social, physical, and emotional changes as they begin to move from childhood to adulthood (Eccles, 1999; Hurd, 2000; NMSA, 2010; Wormeli, 2011). Students at this age begin to develop self-awareness, particularly in relation to their skills and abilities (Eccles, 1999). This life period is also a time when psychological and behavioral problems often arise and when students can begin to disengage from school (Eccles, 1999; Gentry, Gable, & Rizza, 2002; Hurd, 2000). The variability in the growth and maturity of students during early adolescence makes this a particularly challenging time socially, emotionally, physically, and intellectually (Balfanz, Herzog, & MacIver, 2007; NMSA, 2010).
The term middle school refers to a school with some configuration of grades from fifth through eighth that is governed by a philosophy that recognizes the unique needs of students of this age (AMLE, 2011). The concept of a middle school began in the mid-1900s as an alternative to the junior high school. A true middle school is more than just a configuration of specific grades. A true middle school, as defined by the AMLE’s seminal work, This We Believe, focuses more on cognitive and social needs of the whole student, encourages interdisciplinary activities and teacher teams (Akos, 2005; AMLE, 2011; Erb, 2006; Manning, 2000; NMSA, 2010).

George et al. (1998) explained that the “overall aim of instruction in the middle school is to achieve a balance between teacher-directed and student-directed learning” (p. 231). A true middle school offers flexibility in scheduling, grouping, and planning. This flexibility corresponds to the emotional, social, physical, and academic needs of early adolescents (George et al., 1998; Musoleno & White, 2010).

According to the NMSA “education for young adolescents must be developmentally responsive, challenging, empowering, and equitable” (NMSA, 2010, p. 13). These understandings are evident throughout the middle school, from the leadership down to the students. Shared leadership and a supportive school atmosphere should provide a meaningful and purposeful environment for middle school students (Dowden, 2007; George et al., 1998; NMSA, 2010). The specific grade configuration of a middle school is not of utmost importance rather the significance of a middle school is in its philosophy (Erb, 2006; George et al., 1998).
Student Experience With Science

Many have documented that students’ attitudes about science decline sometime in secondary school (Bennett & Hogarth, 2009; George, 2006; Logan & Skamp, 2008; Osborne et al., 2003; Turner & Ireson, 2010). A decline in interest in science classes, at a time when many students have options about courses and levels of courses to take means less students are prepared for advanced science courses in college, which in turn allows less students to enter science careers (Osborne, 2003). It is suggested that sometimes secondary science is less challenging and more repetitious which is more evident in an era of standardized testing (Turner & Ireson, 2010). Science is also sometimes perceived as being divorced from everyday life making its topics seem irrelevant and misplaced (Aikenhead, 2006; Bennett & Hogarth, 2009; Logan & Skamp, 2008; Osborne, 2003).

Osborne (2003) indicated that there is some disparity between students’ negative attitude toward school science and their more positive attitude toward technology and science in the world around them. Bennett, Luben, and Hogarth (2006) indicated that there is some evidence that shows students in classes with context-based/STS approaches foster more positive attitudes to school science than conventional courses. There is more limited evidence to suggest that context-based/STS approaches foster more positive attitudes to science more generally than conventional courses (p. 364).

Nearly all students experience science in out-of-school settings. Students most often view these experiences as distinctly different from the science they experience in school (Griffin, 1994; Rennie, 2007). The large amount of science information available on the internet and television offer students easy access to a variety of science experiences that may or may not be acknowledged by school science.
Access to the students’ lived experience. A relationship of equality between the researcher and the child as a research participant is integral to this study (Grumet, 1988; Witherell & Noddings, 1991). Connelly and Clandinin (1990) suggested that the relationship between the research and the participant should be “more than acquaintanceship, but one which constructs a ‘caring community’” (p. 4). The child is not an adult in a smaller body nor is the adult a child in the large body. While there will always be perceptions of one party being more or less in control, it is important to mitigate this so that the students felt able to speak about their personal experiences (Christensen, 2004; Mayall, 1994).

Mayall (2004) suggested that the behavior of the research participant relates more to the type of power relationship involved between the participant and the researcher. Many individuals like to please people who are perceived to have power. In this way, perceived power is the issue, not the age status of the participants. This suggests that when doing research with children, researchers need to be aware of the power relationships that exist and how they are perceived. The researcher holds a particular status because he is the one conducting the research, and he has the particular knowledge and understanding to analyze and interpret the children’s data. Mayall (2004) wrote that “the attempt must be made to forward children’s interests, both theoretically and through attention to the structures which control their lives” (p. 12).

Working with students to uncover their lived experience is a balancing act. There is a tension between the child participant and the adult researcher, time spent feeling out each other’s reactions to see what is acceptable, how a joke will be taken, what a certain look means. By middle school, students have been involved in the game of school for
almost 10 years. “Space for self-discovery is filled by ready-made interpretations of what students are like and what they need” (Batchelor, 2006, p. 800). Students understand the rules (though they may not always follow them) and the consequences. They know that to be a good student requires “order, silence, and stillness – in other words, compliance” (Leafgren, 2008, p. 332). They know what adults in the school represent and what they expect.

Allowing students to speak their voices is like peeling an onion. Each student has layer upon layer of experience, nuance, and emotion. Not often are students in school asked to express what they truly feel, and if asked for their input, students tend to proceed very cautiously, looking to the adult to gauge the adult’s reaction so that the student can respond accordingly. Gaining access to the students’ stories entails attempting to develop a level of trust and equality with the students so that they understood the role of the researcher as one of an equal (Glesne, 2006).

**Revealing meaning.** Stories help one to understand how people create meaning from their lives (Chase, 2005). It is this understanding that allows one to form relationships with other persons. Polkinghorne (1988, 1995) suggested that what we see of another person is only what that person allows us to see of them. Stories help us to understand some of what is missing, that what cannot be seen. Thus, our understanding of that person increases. If, as stated by Witherell and Noddings (1991) “education is to take seriously both the quest for life’s meaning and the meaning of individual lives” (p. 3), then narrative is an integral part of education. “We begin to experience the world from the first moment of life, and as we grow, we create meaning from the varied events of our lives and attribute significance to our compilation of experience” (Hutchinson,
Narrative meaning functions to give form to the understanding of a purpose to life and to join everyday actions and events into episodic units. It provides a framework for understanding the past events of one’s life and for planning future actions. It is the primary scheme by means of which human existence is rendered meaningful (Polkinghorne, 1998, p. 11).

It is important that narrative research offers the reader an opportunity to revisit her own understandings, thoughts, and emotions about the topic discussed. Enough detail should be presented that the reader can understand the participant’s story and begin to reflect on his own story. “Audiences whose members identify with the narrator’s stories might be moved by the researcher’s interpretation to understand their stories in new ways and to imagine how they could tell their stories differently” (Chase, 2005, p. 668). In this way the reader becomes part of the narrative as well; the reader’s story becomes part of the fabric of the stories woven together through the use of narrative (Clandinin & Connelly, 1991).

**My Narrative – The Progressive**

The second part of *currere* is to contemplate the future, to see oneself in the future and imagine one’s place in it; to experience where and what one will be in this future time. “Imagine a future, perhaps a year hence or perhaps several years hence; describe it (Pinar, 1975, p. 10). In this section I contemplated how I envision science education in my future. It was important for me to engage in the progressive as it puts forth my vision, which allows others to understand my desired path. I encourage the reader, as I
encouraged the research participants, to engage in the progressive as well. “Releasing the imagination means moving into the future” (Pinar, 2004, p. 128).

The recent mantra in education of “efficiency and accountability” has reminded me of economics classes I took as an undergraduate. In those classes we often talked about widgets, which then referred to a made-up object of production. Widgets were used as a placeholder, the object of production, to discuss business models and understand economic principals. According to Au (2009), “this logic . . . asserts that the endpoints of predetermined objectives and/or standards alone drive the educational process (the production of educated students)” (p. 23). When we use economic terms to refer to the education of individuals, we essentially reduce our students to widgets, a product manufactured in our schools. Pinar (2004) suggested that this business model of schooling encourages teachers to be trained as “social engineers directed to manage learning that is modeled loosely after corporate work stations” (p. 27). Under this model “intelligence is viewed as a means to an end, the acquisition of skills knowledge, and attitudes utilizable in the corporate sector” (Pinar, 2004, p. 28). We come to view students as products of the factory of instruction.

When I think about the future, I envision a movement away from this business concept of education toward a concept that willingly embraces the individuality which is human. I envision a movement away from cut and dried descriptors where students are expected to be at a certain level in a certain subject on a certain day. I imagine a place where the students and I can teach each other and learn together.

I envision a science to be similar in nature. I see a school science that encourages true student interest and inquiry. Let’s go outside and learn about our school yard, its
plants and animals. Let’s examine our schools for energy consumption and have students make real plans about how to effect change in their school’s energy use and budget. Maybe students could work on projects based on interest rather than grade level. [Remember here that I am envisioning what I dream to see in my future. “Don’t for example conclude that an imagined futuristic state is unreasonable” (Pinar, 1975, p. 10)]. Let’s move school science to a science that is real and relevant, interesting, and inclusive.

The science I foresee recognizes the usefulness of science, while acknowledging the debate that is essential to the process of science. This type of science also includes the way science is experienced in the classroom – science as a subject of inclusion, not of exclusion; science that is relevant and useful; science in which students work not to get the right answer, but where students work to get an answer and discuss this answer in the realm of their reality.

A science like this would be useful to the larger society. It would allow individuals to consider conflicting information and make informed decisions about their world. It would allow people to understand that debate is essential to science. This science would welcome the individual rather than opening doors to only those good enough for the science that is accepted as truth.

Summary

This literature review began with an explanation of story and narrative. Using the technique of narrative, I shared stories of my science education experiences which allowed me to accomplish several goals in this chapter: 1) it offers the reader the opportunity to understand how I came to the research questions for this study; 2) it
allowed me to examine the literature pertinent to the topics in science education which influenced my journey to this research; and 3) it offered me the opportunity to begin to engage in my own process of currere and thus encourages the reader to consider relating this process to his own lived experiences of science education.

Through my examination of the literature I found that the student voice is one seldom heard in science education, yet is one relevant to the issues at hand. This study attempted to gain an understanding of students’ personal experiences of science as gathered from their personal science stories in an effort to make public the educational experience of a student in a middle school science classroom. Wiggins (1975) suggested that “one of the challenges of stories is to imagine the ‘other’” (p. x). In this case, the other is someone that we have all been (a middle school science student), but that many have forgotten or deemed unimportant.

My research, therefore, attempted to engage a class of middle school science students in their own journey of currere, in an effort to respond to the following questions:

**RQ1:** What lived experiences does a middle school science class bring to the science classroom?

**RQ2:** What future relationship with science does a middle school class foresee?

**RQ3:** What are the everyday experiences of a middle school science class?
CHAPTER III

METHOD

We have gone just about as far as we can go in understanding the nature of education by focusing on the externals . . . we must take our eyes off them for a time, and begin a lengthy, systematic search of our inner experience. (Pinar & Grumet, 1976, p. 4)

The purpose of this research was to recognize the curriculum of a middle school science class. A qualitative methodology is most appropriate for this study in order to hear the class’ voice and reveal to the understandings of a middle school science class (Hesse-Biber & Leavy, 2004; Marshall & Rossman, 1999). Research about student understanding is bounded by the type of instrument used to gather information about students’ experiences. Pissanos and Allison (1993) proposed that “traditional positivistic research techniques, such as direct observation, limited response questionnaires, or inventories fail to acknowledge students as the ultimate insiders and experts regarding their schooling experiences and the constructed meanings those experiences hold” (p. 426). Barmby, Kind, and Jones (2008) indicated that “different instruments try to measure different aspects of attitudes toward science” thereby making it difficult to compare results (p. 1077). The interest of this study being to present the experience of a class from the students’ perspectives necessitated that the data collected be student-driven and open-ended.
The goal of a qualitative inquiry is to provide insight and a depth of understanding into a specific experience. A qualitative study provides the opportunity to gain insight into the multiple meanings, varied understandings, and unique realities that exist in the world (Gillham, 2000; Glesne, 2006; Marshall & Rossman, 2011; Morse & Richards, 2002; Richards, 2005; Wolcott, 1994). This qualitative research study allowed the middle school science class an opportunity to share its voices, understandings, and experiences of science, thereby giving others a glance into their world.

When considering a qualitative study, a researcher must take into account a conceptual framework, a systematic design, and an integration of the two. While a systematic design is a way to begin a study, the design of a qualitative study needs to be flexible to allow for new avenues of exploration as well as dead-ends (Patton, 1990; Yin 1993). In this study the conceptual framework of currere along with the general design of a case study provided the scaffold. The two are integrated through the narrative presentation of the data. General understandings related to qualitative research, student voice, and narrative are woven together as scaffolding to support the research design and method.

The qualitative research study itself should answer a question and provide information about a particular phenomenon. Sometimes called the “should-do-ability, do-ability and want-to-do-ability” of a study, these factors help lead the researcher toward a study which is meaningful to both the researcher and others (Marshall & Rossman, 2000, p. 9). The topic of this particular research emerged after I wrote and implemented several STEM education grant-funded projects, aimed at secondary (high school) students and teachers, to encourage students toward further study in STEM-
related areas. These projects focused on influencing the future education and career choices of students, but they did little to determine where the students were currently or where they had been. The students’ personal experiences played little if any role in the planning and execution of the project design or activities.

One of the primary reasons for conducting a qualitative study with a middle school class is that voices of the students, speaking from their own experiences and understandings, are seldom heard or considered in discussions about science education (Jenkins, 2006). When a science student is asked for her opinion, it is often in the form of a quantitative measure or survey conceived by, designed by, and written by adults for students (Osborne & Collins, 2001). Seldom are students offered the opportunity to speak freely about any of their personal experiences in school or their expectations or desires for the future. Having taught for five years in a middle school science classroom, I knew that the middle school classroom was full of stories, about the student himself, his relationship with the multiple realities of his experiences, and the conglomeration of the multiple realities of the students in a class. As Geelan (2007) offered, “the life stories of your students are shorter, but no less rich and complex, and likely much less ordered and understood” (p. 2). In an effort to understand a middle school class, to bring the voices of the class to the forefront, I offered this class an opportunity to speak in its own words. In this way I hoped to hear a curriculum of this middle school science class.

*Currere* is used as a way to access the multiple realities and relationships that exist among a class of middle school science students. Using *currere* to access the science experiences of this class suggests that the students in this class have lived experiences that carry more understandings than those which the class chooses to share at
school. The class’ science stories are far more meaningful than those in which they engage in only the science classroom. The collection of these multiple stories allows for a new way to understand science students in the classroom. In this way the significance of *currere* is two-fold, not only does it allow our students to start to access their larger and more complicated life, it also allows educators to see students more as multidimensional beings, more than the sum of demographic information, test scores, or how they act in class.

In acknowledging the class’ voice this research establishes that knowing is constructed. The class’ conversations reflect the understandings of the class that they have created through their personal experiences and social realities. The class’ conversations should not be taken as one truth but as “the rich, complex, contentious matrix of understandings that we share as social beings acting in social situations” (Geelan, 2007, p. 9). As well it should be noted that the class may not be completely comfortable with sharing their voice, which may require that both the researcher and the reader have patience with a class which is new to the idea of sharing its stories (Lincoln, 1995). Hearing the class’ *currere* will allow for the class to feel valued for the sum of who they are in their own social realities, rather than being valued for being whom others – parents, teachers, school – expect them to be (Batchelor, 2006).

**Case Study**

Yin (2009) defined a case study as an inquiry that “investigates a contemporary phenomenon in depth and with its real life context, especially when the boundaries between phenomenon and context are not clearly evident” (p. 18). For this study the
context (the middle school science classroom) and the phenomenon (the currere of a middle school science class) were inherently intertwined. A case study allows for the influences of each upon the other, acknowledging the impossibility of separating the two.

Merriam (1998) defined a case as “a thing, a single entity, a unit around which there are boundaries” (p. 27). The case being explored in this research was a particular middle school science class, which was referred to as fourth period science. Although any small group of students could have been considered a case, this particular class which included this group of students meeting in this specific classroom at this certain time each day provided a naturally defined case with rich research potential.

This case researched in this study was the class as a whole, which consisted of all the students in this class. All of the students in this class had a voice in the narrative of the classroom and all contributed to the currere of the class. By the time the research took place, in the last quarter of the school year, these individuals had been studying science together for seven months. From my experience as a classroom teacher, I knew that each class was unique and had its own personality. The science stories of this class were already inherently intertwined and were exclusive to this case.

The choice of this particular class, fourth period science, was one of mutual convenience for me, the teacher (Mr. K.), and the school administrator. The school administrator suggested that I work with one of Mr. K’s classes. I had worked with Mr. K. during a professional development workshop prior to beginning my research. When I approached Mr. K. about my research, he offered this class as one of his “better” classes (which I discovered later to mean that the students in this class were more well-behaved and more successful on assessments than the students in his other classes [Gordon et al.,
2009; Pope, 2001]). The time of day of this class fit well with my college teaching schedule. In addition, this science class met immediately prior to the students’ lunch, and most of the students in this class had a study hall later in the afternoon. This schedule allowed for two potential unstructured times (lunch and study hall) when I could meet with students from this class to conduct focus group interviews.

While the choice of this particular class, fourth period science, was one of mutual convenience, the selection of this particular school as a research setting was intentional. The high graduation rate in this district along with the students’ high passage rate on state mandated tests suggested that these students were academically successful. The higher than average number of college graduates in the general population of this school district indicated that these students were surrounded by individuals who valued and were able to attain higher education. Given these factors, these students may be more likely to take the higher level high school courses required (advanced placement mathematics and science classes) to allow them uncomplicated entry into STEM programs in college.

**Setting**

This inquiry was rooted in the classroom –where I learned to love science, learned to hate science, learned to understand science, and learned to question science. My journey through this research allowed me to reenter and experience the middle school science classroom not as the student, the parent, or the teacher, but as an observer with unique experiences, knowledge, and understandings. As most individuals in this country experience a classroom at some point in their lives, this setting is one familiar to most.
The setting for this research was the science classroom. It was important for this research to be in the classroom in order to keep the students’ narrative in their shared context, to put actions with words, and to elicit meaning from their discussions about science. Students may talk about what they do at school, but rarely do we as outsiders gain a true understanding of the students’ classroom experiences from inside the classroom. Each student in this class lives through his individual experience, but it is the confluence of those experiences that make up the narrative of the science classroom, which in turn influences the experiences of each individual in the classroom.

The school. I conducted my research with one class of seventh grade science students, fourth period science, at Brookwood Middle School (BMS) during the last quarter (the end of March through the beginning of June) of a school year. BMS is located in a suburb of a large Midwestern city. The town which houses this middle school is largely populated by White, middle- to upper-middle class families (91.2%). This community is well educated: approximately 94.5% of the residents in this community are high school graduates or higher, compared with a state average of 86.8%. In addition, 46.2% of the residents hold a four-year college degree or higher (compared to a state average of 23.6%) [U.S. Census Bureau, 2010]. The school district itself has a 99% graduation rate (Ohio Department of Education, 2010).

For the six years prior to this research, the school district in which BMS is located received the highest effectiveness rating based on four statewide measures of academic performance (meeting or exceeding the goal of 75% efficient on state achievement tests, meeting or exceeding 85% efficient on state graduation test, meeting or exceeding the 90% state requirement in graduation rate, and meeting or exceeding the 93% state
requirement in attendance). The overall passage rate of BMS students on all areas of yearly state mandated tests is typically 90% or higher. Of the five areas tested (prior to spring 2010 – math, reading, writing, science, and social studies) science and social studies have always had the two lowest passage rates (although BMS students have had lower passage rates in science and social studies, these passage rates are still considerably higher than the state average passage rate[Ohio Department of Education, 2010]).

The district in which BMS is located has about 3,800 students. The racial makeup of the district’s students is 91% White, 5% Asian, 2% Black, and 3% Hispanic, with 1.6% of individuals reporting two or more races. About 6% of the students report as economically disadvantaged. According to 2010 census data, 4.6% of individuals in this community are below poverty level, compared with a state average poverty level of 13.6% (U.S. Census, 2010).

About 500 middle school students attend BMS, which houses all the district’s seventh and eighth grade students. There are three seventh grade and three eighth grade science teachers at this school. Students come to BMS from an intermediate school which houses all of the district’s students in grades five and six. There are four district elementary schools (grades K-4) which feed into the intermediate school. The district has one high school.

I had been involved with BMS during the year prior to this research throughout the writing and implementation of a state-funded grant for STEM education. I was primarily involved with planning and implementing teacher professional development activities with the BMS faculty, and as a result I had developed a trusting relationship with the faculty at this school as well as with the district administration. Although I had
not previously interacted with BMS students in the classroom setting, I had spent about 10 days at the school during the grant work including a day of student observation during a school-wide STEM activity day. I completed eight hours of student observation in the fourth period science classroom prior to beginning my focus group interviews, so I had become familiar with the classroom and daily school schedule. As a result of these interactions I had developed good rapport with many of the teachers and administrators at the school and many of the students had seen me in the school prior to beginning my research.

**The classroom.** The classroom at BMS in which I observed looked similar to many other science classrooms in which I had taught, learned, and volunteered. The room was basically a square with a door to the hallway on one side and, diagonal to this, a door which led to an outside grassy area on the back side of the school. On the wall with the outside door were a few large windows and a counter space with some upper and lower cabinets. A sink and a cart of plants under grow lights were on the other side of the room. A bulletin board labeled “absent board” on which were posted handouts for students who had missed class hung on the wall near the sink. A screen at the front of the room, which hung down over a portion of the chalkboard, was used to project the day’s schedule, PowerPoint presentation, or websites related to the classroom topic of discussion. On a bulletin board hung above this screen was a list of classroom expectations, such as “Respect others” and “Come to class prepared”. Opposite to this was the back wall, on which hung science posters and some science vocabulary words. There were eight round tables for students in the room with four chairs at each table. The room was very neat and did not feel cluttered. Yet due to the grow lights, the
vocabulary on the wall posters, and some science items sitting on counter, there would be no mistaking this space as housing any other subject area but science.

The case. The case in this study was a particular class of seventh grade science students, members of fourth period science at BMS. In order to access the class’ lived stories of science, I spent every day of the fourth quarter of the school year attending science class with these students. I attended class for a total of 40 days. Immersion in this setting allowed me to become part of the class’ daily science routine and offered me the opportunity to gain an understanding of the complex awarenesses and understandings that exist in the class’ relationship with school science. As stated by Intrator (2004), “the truest and most accurate way I can learn about the way teaching and learning happen . . . is to experience what adolescents experience throughout a school day” (p. 20).

The class consisted of 12 girls and 10 boys, all of whom appeared to be White. The students at this school do not wear a uniform. The students typically looked neat, clean, and well-groomed, with combed hair. The usual student attire was t-shirts or sweatshirts, jeans or shorts (as the weather dictated) and tennis shoes. Two girls and none of the boys wore glasses. It is not known and it was not evident that any of the students had special needs. Two female students in this class left school early once or twice each week for specialized athletic training, but this rarely affected their science class attendance.

The students completed a short demographic survey. Results of this survey indicated that 19 of the 22 students had two parents who attended college. Only one student indicated that neither parent attended college. Other information from the survey revealed that all of the students had played an organized sport in the year prior to the
survey, 19 of the 22 students had watched a television show with one or more parents in the week prior to the survey, and 14 of the 22 students had read an article in the newspaper in the week prior to the survey. Swanson (2009) noted that upper-middle class parents “used educational institutions to reproduce their class standing in their children” (p. 406). The class lives in and attends school in a community which is well-educated. In providing children with activities where they can use their minds well, the class has parents who are educated and involved in their children’s growth.

**Consent.** While the superintendent, principal, and teachers understood and agreed to this research study, it was necessary for me to acquire the participants’ assent (Glesne, 2006). Since the participants in this study were under 18 years of age, and therefore considered minors, it was necessary for me to attain the consent of the participants’ parent or guardian as well. I verbally explained the purpose of my study to the class, detailed their rights with regard to the research, and asked them to read and sign an assent form. I also explained that because of their status as minors, a consent form would need to be signed by a parent or guardian and returned to me. The teacher assisted with this by including the return of the consent form as part of assigned homework. Consent forms were signed by a parent or guardian and returned by all of the students in this class.

**Data Collection Techniques**

**Observation.** Observation has been used by humans throughout history to make sense of the world around them. Observation involves the use of all of the senses; it is
through the use of the senses that one perceives safety and danger, comfort and anxiety, fear and reassurance. Observation gives us deeper insight into ourselves and others.

Observation is particularly important in classroom research with students because it allows the researcher access to the multitude of classroom interactions that occur at any given time. These activities serve to develop the “thick description” (Geertz, 1973) of the setting and the participants. Many things occur in the classroom without much thought or acknowledgment: the tapping of a pencil, the glance to a classmate, the flipping of pages. Likewise a classroom can be uncomfortably warm or smell like old gym socks. It is the experience of being in the classroom as an observer that provides the researcher a glimpse of the classroom environment, the environment in which the students learn science each day of a particular school year. This classroom environment creates the space in which the class learns science and it influences how the class perceives science. Observation allows the researcher to more fully understand the participants’ stories in that it allows the researcher to begin to realize some of the context of the stories.

The beauty of observation as a qualitative tool lays in the fact that it allows the researcher to come to an understanding of what is important to the participants themselves. Observation allows the researcher to become a vicarious part of the participants’ world, without undue influence in that world (Adler & Adler, 1994). It allows for a glimpse of participants “in real-time, in a natural situation” (Cotton et al., 2010). Thus, the purpose of observational data is to describe the setting that was observed, the activities that took place in that setting, the people who participated in those activities, and the meanings of what was observed from the perspective of those observed (Patton, 1990).
Observation is important to case study research. Stake (1995) described case study as “noninterventive and empathetic”. (p. 12). Observation allows ‘what is’ to occur with minimal influence from the researcher. In this research study observation provided the researcher and the reader a unique glimpse of the various realities that occur in this classroom setting during fourth period science over the course of the last quarter of a school year.

I conducted initial observations in the classroom for about eight days prior to beginning focus group interviews with the students. I was in class and seated before students arrived and I didn’t leave the classroom until after the students left. During this initial observation period I typically sat in a chair at the back corner of the room, next to a counter on which I could write. I would occasionally walk around the class while the students were engaged in seat work, but I interacted minimally with the class at this point in time and I concerned myself primarily with generating descriptive field notes.

While observing I followed Wolcott’s (1994) suggestion of “observe and record everything, observe and look for nothing – that is, nothing in particular, and look for paradoxes” (p. 161). I focused myself not on what was being taught, but on the students themselves: what they were doing during class, with whom and with what they interacted, and how they responded to the teacher, the materials, and others in the room. I took notes about the surroundings. At this point in the research, I wrote observation notes and sketched diagrams by hand in a notebook.

I typically left the school after the students left the classroom at the end of class. Although I often chatted with the teacher before or after my observations, my conversations were about the lesson presented or science teaching in general, not about
the class or my research. On several occasions I tape-recorded my personal thoughts and feelings from the observation in my car before I left the school parking lot.

This length of initial observation served several purposes. Because I became a regular fixture in the science classroom, the class began to expect me to be there and became comfortable with my presence. The students’ comfort level with my presence in the classroom allowed for trust to build between myself and the class. This trust encouraged the class to fall into natural routines (typical classroom behavior in which they might not engage when there is a one-time adult visitor in the room). Paradoxes became more obvious to me as I became familiar with the students and their daily routines and behaviors. This length of observation enhanced the “thick description” of the participants and the setting, which added the credibility of the research (Connelly & Clandinin, 1990; Geertz, 1973).

Following this initial period of observation, I interacted more with the students during the class, but my role was that of a casual observer, not a teacher or tutor. The class was aware of my academic affiliation and that I was conducting research about students’ experiences in science. The students were also aware that I would be interviewing them about their science experiences at some point during the quarter.

In the classroom the students sat at single-gender tables (their choice). After my initial observation period I often chose to sit at one of the student tables rather than at the back of the room during the class. I was able to spend at least one class period at each table before completing my research. While sitting at a student table, I worked class assignments along with the class, observed their work and behavior, and occasionally answered procedural questions supporting the teacher’s lesson. I sometimes questioned
the students while I was sitting at the table, but I only questioned for clarification or explanation of what they were doing or saying. I did not question students about their knowledge of the content. I tried to maintain an unobtrusive presence in the classroom and would only question the students when it was an appropriate time for anyone in the class to be talking. I took occasional notes while I was at the tables, but I often saved my remarks to tape record in the car following the session. I did not want the class to feel uncomfortable with my presence in the classroom as if I were spying on them. As the topic of my research was the class’ experience of science, I did not make observations about the teacher or his pedagogy.

When I wasn’t sitting at a table in the classroom, I was sitting in the back corner, walking around the perimeter of the room, or assisting the teacher with passing out materials, repeating directions, or answering basic procedural questions. I read the textbook when the students were assigned a section to read in class. I continued to develop my “thick description” throughout my stay in the classroom (Geertz, 1973).

**Focus group interviews.** Van Manen (1990) suggested that there are two main purposes to conducting any type of interviews with participants in qualitative research projects. Interviews can be used to establish the basis of a study – to understand the big picture of a phenomenon – or they can be used as a method of understanding the individual meaning a participant places upon a situation or event. Using the participant interview as a research technique allows the participant’s role to shift from being the object under consideration to becoming the narrator of the story being told, the voice that is being heard (Chase, 2005). Interviews were used in this research as a way to gain
access to the participants’ memories, dreams, and understandings of their personal experiences of science.

In qualitative research, it is important to have good rapport between the researcher and the participants. The researcher needs to be able to see the world from the position of the respondent and to share this view with the reader. While this closeness between researcher and participant is significant, it is also important that the researcher continually maintain distance from the participants (Fontana & Frey, 1994).

In this research, focus group interviews were used to gain participants’ perspectives, memories, and thoughts about their experiences of science. Group interviews allowed for a great deal of data to be collected at one time, which was helpful due to limitations of the students’ free time during the school day during which they could participate in interviews. I also decided to engage the class in focus group interviews because it allowed me to interact with the students “in an atmosphere more natural than artificial . . . and more relaxed than the exposure of a one-to-one interview” (Marshall & Rossman, 1999, p. 115).

Focus group interviews tend to be productive with school age populations. This was particularly relevant to the group being studied, as the class seemed more apt to engage in conversation when they were with their peers. This group environment also seemed to encourage deeper conversation, as each participant wanted her turn to talk and wanted her point to be understood. Often one student brought up a topic, which conjured forgotten memories for the other students, allowing for a far richer and deeper discussion. Being part of a group also provided some checks and balances in that fellow participants often verified another’s information (Fontana & Frey, 1994; Patton, 1990).
The group dynamics of focus group interviews can also offer insight into the topics discussed. “Close attention to the ways in which research participants tell stories to one another also prevents the researcher from assuming that she knows ‘the meaning’ of any particular anecdote or account” (Kitzinger, 1994, p. 113). Osborne and Collins (2001) offered that group interviews also allow students the opportunity to be silent, rather than to feel the pressure of having to respond to an interviewer in a one-on-one setting. Through focus group interviews “priority is given to the respondents’ hierarchy of importance, their language and concepts, their frameworks for understanding the world” (Kitzinger, 1994, p. 108). Acknowledging the conversation between and among students also acknowledges that students “do not speak with a single voice” (Jenkins, 2006, p. 69).

A semi-structured interview protocol allowed me to engage all of the participants in discussions about their experiences without completely directing the flow of the conversation. As new information emerged in a conversation, new probing questions were added, new ideas were discussed, and new pathways were followed. As the researcher, I constantly negotiated a back-and-forth between the focus of the research and the path of the stories being told. The semi-structured interview questions (Appendix B) were merely a starting point for the discussions with the participants.

Most of the interviews occurred during a study hall period that the students had following their lunch period (which followed their fourth period science class). The interviews typically took place in a quiet corner of the school library, an area with a table away from the main flow of traffic. Participants in the various focus groups were selected randomly; I would typically ask the students whose table I sat at during the
science class if they were available to talk to me during their study hall period. The students did not have study hall every day, and some students had other work assigned to them during study hall, so a focus group interview occurred when a small group of students was available to meet with me. Each interview with a group of three to six students took place during the 45-minute study hall period, a length of time which allowed for everyone to participate in the discussion and also for participants think about their responses and provide clarification as needed (Glesne, 2006).

One interview with two students occurred during the class period after these students had completed a test. These two students finished their tests rather quickly and the teacher suggested that I interview the students at that time. The students consented to this arrangement. These interviews were conducted in the hallway outside of the classroom. Since it was during the regular class period, the hallway was empty of students and the students were free to talk.

Two students were interviewed individually because they were not available during times when the focus groups were meeting. I interviewed each of these students in the library during a study hall using the same semi-structured interview protocol. These students were each interviewed toward the end of the quarter by which time the students seemed comfortable talking to me individually.

All of the interviews were audiotaped. I transcribed the tapes at home shortly after the interviews took place. Once the transcription took place, I set aside the data until all the data had been collected before engaging in analysis.

**Short demographic survey.** In order to collect some demographic information about the class, I asked the class to complete a short pencil and paper survey. The survey
asked about activities outside of class in which the students were involved, activities the students completed with their families, and educational background of their parents. Early in the interview process I had the sense that the students were very active in activities outside of school and that the students spent time doing activities with their families. The data collected from this survey were used to add to the thick description of the class. The survey questions are listed in the appendix (Appendix C).

**Personal notes.** Personal notes from my experience as the researcher were also collected to inform this study. I often made personal notations while I was taking observations, which Richards (2005) refers to as a “log trail”. I usually wrote my initials next to these notes so that I would know they were from my point of view and not the students. Sometimes these notes were made on a personal tape recorder, following a session in the classroom. This dialogue with myself served to remind myself to stay on task with my research questions, provided myself with early glimpses of data interpretation, and filled in some blanks in my understandings (Wolcott, 1994). These notes also served as my diary of the present during this research experience. These notes are where the analysis and interpretation of the data actually begin. An example of my personal notes is listed in the appendix (Appendix D).

**Data Analysis**

The analysis of the data followed the steps of “data reduction, data display, and conclusion drawing/verification” (Miles & Huberman, 1994, p. 10). This style of analysis is an iterative process, not a straight line from the first step through to the end. In addition, data analysis does not occur in a vacuum. Although the data gathering phase
may have ended, the story is just beginning to be told. As the researcher continues to live her life, the meaning of the story itself, and in turn the analysis and interpretation, continue to evolve.

The data were reduced through the use of coding. Coding is a method of data reduction, a way to begin to begin to isolate themes that run through the data. Richards (2005) lists three specific types of coding: “descriptive coding, topic coding, and analytical coding” (p. 88). After transcribing the data I engaged in descriptive coding, recording general demographic-type information about the speakers of the passages recorded. While topic coding I labeled passages with topics being discussed by the class. This was followed by analytical coding when the themes began to emerge from the data. The observation data and the transcribed focus group interviews were coded according to this method.

The data were hand-coded, color-coded, and physically grouped as topics emerged. Data were further reduced as topics were able to be collapsed into over-arching themes. This process of coding and grouping occurred over the period of about 12 months. The data were lived with, and as a result, aspects of the data were considered and reconsidered. The time spent living with these data encouraged the researcher to attempt to truly understand what the data revealed. This process continued until a point was reached at which it seemed the data had no more to say at that particular moment. Yet because this research is a narrative, the story itself will continue to evolve and develop as the researcher and others read, consider, and remark on this study.

**Trustworthiness.** Because qualitative research understands the world as socially constructed rather than as a concrete reality, qualitative researchers use trustworthiness as
an assessment of rigor. Trustworthiness was primarily addressed by using multiple data collection methods, building a thick description of the case, and providing a statement of the researcher’s biases (Glesne, 2006; Merriam, 1998). Multiple types of data were collected, including observations, focus group interviews, and personal notes, which add to the trustworthiness of the data. The length of time spent at the research site allowed enough time and familiarity for routine to occur and anomalies to be noticeable.

Because this was a qualitative study, my reflexivity as the researcher and author was also critical to this research. As the data, the narrative, and the stories flow through the research, “I am my instrument” (Clandinin & Connelly, 2000, p. 36 italics in the original). Therefore, not only do the participants and the setting need to be described, but I as the researcher and what I bring with me: my assumptions, my context, and my biases, need to be exposed as well. My participation in the process of currere throughout this research encouraged the elucidation of my context.

There were many voices in this research process. I needed to be aware of where and when my voice was being heard over that of the participants involved in this research. As the researcher, I attempted to control this by being open and honest throughout the research process. Being reflective by keeping written and oral notes helped me as researcher to keep my voice somewhat separate from that of the participants. My intention is that the reader will also be able to distinguish my voice from that of the participants. (Chase, 2005; Clandinin & Connelly, 2000)
Limitations

This research study was limited by numerous factors: the suburban school district and the specific class within this school, the length of time spent in the science classroom, and the accessibility of the students outside the class time. Due to these limitations, this case should be viewed independent of other studies and should not be looked at to provide generalizations about middle school science students. This research and its findings may encourage other educators to both seek the stories of their students and to carefully consider the messages of these stories.

Summary

This chapter described the qualitative method of case study within a framework of currere that was used in this research to gain access to a middle school class’ experiences of science. The study took place during the fourth quarter of the school year with a fourth period, seventh grade science class at Brookwood Middle School. I spent each day of this quarter in the science classroom with this particular group of students. I made observations in the classroom to provide a thick description of the setting and the research participants.

The student participants were interviewed as small focus groups, with the exception of two students who were interviewed individually due to scheduling conflicts. I questioned the class using a semi-structured interview protocol. This allowed for all students to be asked the same general questions but also for the conversations to go where they wanted to go. The overarching questions from which the interview questions were generated are:
**RQ1:** What lived experiences does a middle school science class bring to the science classroom?

**RQ2:** What future relationship with science does a middle school class foresee?

**RQ3:** What are the everyday experiences of a middle school science class?

I tape recorded the interviews and transcribed them to provide the raw data for analysis. I worked with the data by hand and over time to code and group the data by major themes. I continued working with the data until there was nothing more for the data to say, at that particular moment. Because this is a narrative case study, analysis will continue as everyone who interacts with the data will bring his own story to the research, thereby reaching his own conclusions.
CHAPTER IV
FINDINGS: THE CLASS’ NARRATIVE

This chapter presents the findings of the research within the framework of *currere* (Pinar, 1975). *Currere* uses an individual’s experience: past (regressive), future (progressive), and present (analytical), as a way of locating an understanding of his individual curriculum (synthetical). *Currere* encourages an individual to center himself and his experiences in order to fully participate in his own education. Pinar (1975) suggested the process of *currere* as a way of bridging one’s personal experiences and one’s educational experiences, acknowledging that they are not two separate spheres but one realm unique to the individual who is living the experiences (Sumara & Davis, 1998). By encouraging the individual to dream of her place in the world, where she sees herself in the future, and the influence of past experiences upon her present, an individual can truly begin to find her place and can live fully in the present.

This research intends to bring to light the curriculum of a middle school science class. The framework of *currere* was used as a way to access the students’ personal experiences, their thoughts, hopes and dreams, and their memories. The blending of these allows the reader a glimpse into the science life of the students in this middle school science classroom.

The data in italics are the students’ own words, elicited as a result of the interview questions in Appendix A, or the researcher’s words, written or spoken on the date
indicated. All students’ names have been fictionalized. Specific conversations are kept together as one paragraph if a complete discussion relates to the described topic. A sample of one complete interview is in the appendix (Appendix E).

**R: The Class’ Regressive Story**

Revisiting the past is essential for one to situate herself in the present (Pinar, 1975). An individual is influenced by his past experiences and understandings, by those with whom he has interacted, and by his past hopes and dreams. Bringing these to the present allows one to see his path and to begin to make sense of the life that has been lived so far. Allowing students to participate in this type of thoughtfulness gives educators a unique view of the concepts, understandings, and experiences of science that the students bring with them into the classroom. As the past influences the present and the future, it is here that I started the interview discussions with the students.

All interviews began with the same general question: What is your earliest memory of science? From this question, discussion ensued about prior science experiences. I was often met with a blank stare from the students when I asked them to consider their earliest memories of science. I prompted them to close their eyes and remember. I wanted the students to feel comfortable revisiting their earliest memories of science. I encouraged the students that any answer to my question was fine, that I was there to listen to whatever the students had to say.

**R1: Earliest Memories of Science**

When asked to recall their earliest memories of science, the students were typically silent for a few seconds before someone would begin to speak. In the focus
groups, one student would tentatively begin to share a memory, then others would chime in, adding more details to or their own recollections of the memory being shared. Once one student began to share her experiences, the others would eagerly reveal their early science memories. The focus group format allowed for shared recollections. One individual’s memories often provoked another’s story. These stories seemed to be surrounded by happy memories as they were typically accompanied by smiles and nods of encouragement from the students.

*I probably did science when I was about three or four, because my mom’s a science teacher, so um.... So like she told me all about plants and gardens and stuff because she had a huge one in our back yard. She told me all about the different plants.* (Allison)

*My mom told me stories ever since I was little; our next door neighbors, I used to go pick flowers out of their yard and pick them up and take them over to our yard, so my mom probably taught me all the different flowers because my mom likes flowers and stuff.* (Lea)

*My dad and I also made paper airplanes when I was little, like before kindergarten. We tried to see how far we could throw it and, of course, mine went, like, only a foot.* (Len)

*When I was little I would go to my dad’s office and he had this...well....this microscope, but it was an old one, so it would like shine light on it and I would put my eyelashes in there.* (Katie)

The students’ parents played the main role in these earliest science memories. The students’ recollections usually included the student himself sharing a parent’s interest, profession, or passion. These earliest memories in which parents played a key role were typically from the years before the students entered kindergarten.
R2: Early School Science Activities

The discussion about early memories of science included conversation about science activities in which the students participated during their primary years of schooling. When discussing early elementary school science activities, the students described a science which involved exploration of the natural world around them. Much of what the students described as science activities were observations of life processes, but these observations were quite memorable to the students. Many of the students had similar primary school science experiences even though many of them had attended different schools.

*In preschool, we like grew all these chicken things. We like took the eggs and put them in the...I forget what it’s called, this little thing....wait, an incubator? Yea, they just sat there for a while and then they hatched. (Eddie) We actually saw one hatch. (Lexi) The other ones hatched overnight. (Nora)*

*In preschool we did this thing with bananas and peanut butter.....but I don’t really remember what it was. (Alexa)*

*I’m pretty sure it was first grade when I went to a different school, we had a science lab in that school and I remember doing a butterfly experiment....with the monarch butterflies. We set up an environment and there were like the cocoons and little caterpillars came out.....We had the butterflies in our room for about a month. (David)It was in the room and there was like this net thing, and it was really big and it just sat on the table, and it had these little cocoons hanging off of it and actually, it looked kind of nasty. Then we had tons of little baby butterflies flying around the net. And then we had to let them go...outside....which was kind of depressing. (Alexa)*

*I think I remember them because you got to see how they grow; and then, they, like, turn from a crawling bug to a flying bug. (Kourtney)*

*... building a paper mache volcano...in like, second grade. It exploded but it didn’t explode right and it blew the top off the volcano. Like we put too much stuff in it; it was pretty cool. It got all over my teacher’s face; it was funny. (Nick)*
As the students shared these memories from their early elementary years, they often became quite animated: a look of wonder as one remembered an egg being hatched or a faraway look as one remembered having to set free the butterflies that had morphed in front of her eyes. The tones of the students’ voices registered excitement. The students seemed pleased to have remembered these early science experiences. This positive emotional response seemed to come from not only the memory of the activity itself, but also from the memory of the emotion that occurred during the initial activity.

**R3: Later Elementary School Science**

As the students’ discussions shifted toward the science they did in later elementary school, their memories became more detailed, probably because these memories were closer to the present. Most of the science the students recalled was project-based. [Blumenfield, Fishman, Krajcik, Marx, and Soloway (2000) described project-based science as “opportunities to construct knowledge by solving real problems through asking and refining questions, designing and conducting investigations, gathering, analyzing, and interpreting information and data, drawing conclusions and reporting findings” (p. 250).] With great detail the students spoke of the various hands-on science projects they completed in later elementary school. The students didn’t typically remember the concepts they had learned from these projects. The students, though, seemed to be able to recall the process of each project in great detail. For these students, the procedure seemed to be extremely important. While the students did not often remember the outcome of a project in which they were involved, the students were often able to recall the outcome that they felt they should have gotten.
As is the case with project-based activities, most of these events took place over the course of several class periods and involved some trials and revisions in order for the students to complete the activity. The students recalled that sometimes their teachers arranged competitions among students in different class periods who completed the same project. The students seemed to enjoy these rivalries, but the outcome of the competitions did not seem to be very important to the students.

And in 5th grade we made a fish planetarium out of a bottle with a terrarium. We put water in it, we put grass in it, and then an aquarium out of the pop bottles. (Caitlyn) The fish that I had, they actually had babies! (Lea)

We did bridge making, building bridges out of toothpicks. (Katie)

He gave us a certain number of toothpicks and you had to construct it, and there were directions, and he gave you graph paper and you had glue, pencils and your toothpicks and you put them together on a cardboard. You learned measuring, too. You needed to find the length of something, the width of something... and then he had weights and you had to try to keep the bridge from falling and my bridge held all the weights without falling. (Caitlyn)

...there was like a plastic cup that we hung from like the middle and so that’s where your bridge had to be the strongest...to see how many kilograms it could hold. (Gina)

You kind of learn about, how much certain things can hold and you learn all about all the different bridges and how each of them can hold different, certain amounts of weight, like mass of the weight and stuff... (Lea)

In fourth grade we did that with animals, we got those frogs... (Lexi) Oh that was so fun. (Alexa) And we played with them and stuff... and crabs... (Lexi) ... those things freak me out... (Alexa) Yea, we all got in groups and we had to like, feed them and... what else did we do with them? (Nora)

We learned about alternate sources of energy like solar energy with our solar cars last year. (Alexa)

I like to build things, like, solar cars last year was fun... (Laura)

...you had to like, figure out good products that would work but that would make your car light and like, you would have the solar panels, but you had to make the
car as light as it could be; you had to like figure out how much supplies that we would need, but that’s kind of like math instead of science….(Kourtney)

We learned that you need sun for the solar panels to move, and if it’s shady then it won’t move as well but if there’s wind that’s kind of solar energy…. (Caitlyn)

I still didn’t get how like, solar panels, do it…like how they make it into electricity….and then you guys, your class (to Katie) especially, they made their cars out of like recycled things like my friend, she made the base of her car out of a lacrosse head and flip flops…(Izzy)

In science last year, we did Barbie bungee jumping. What we did was that we had Barbies, and some of them were naked, which was kind of weird, but anyway, so then we tied like a bungee kind of cord to their feet, and the other end was tied to a block and we had to drop the Barbies from a certain height so that when it bounces her hair touches the ground but not her skull….so um……(Katie)

The science in later elementary school seemed to require the active involvement of the students, rather than the purely observational activities of early elementary school.

Although I prompted the students for more information about what specifically they learned from these different project-based activities, most often the students would answer by talking more about the process of the project or answer with vague generalizations.

Katie: We did Bridge making, building bridges out of toothpicks.

KSC: How was that?

Katie, Izzy, Gina: Fun!

KSC: How long did you spend on that?

Izzy: Probably about a month.

Gina, Katie: Yea.

Laura: Maybe a little less.

Katie: Maybe three weeks, yea.
KSC: What kind of things did you talk about when you were making them? Did you talk about forces, or...

Izzy: Not really.

Laura: We just kind of made it.

KSC: Did you test them?

Izzy, Katie, Gina: Yea.

KSC: How did you test them?

Izzy, Gina: Weights.

Katie: With kilograms. (Katie)

Laura: And there was like a plastic cup that we hung from like the middle and so that’s where your bridge had to be the strongest.

KSC: OK.

Laura: To see how many kilograms it could hold.

KSC: Did you, like, chart them or graph them or anything?

Izzy: No.

Laura: We had to draw them on graph paper and hand that in.

Katie: Yeah.

KSC: Like beforehand?

Katie: Yeah.

KSC: But did you compare everybody’s bridges?

Katie: No.

Laura: No.

Izzy: We just kind of like, tore them apart....
My further probing to learn more about specific details of a project typically ended the conversation or led to some frustration from the student at being able to recall an activity, but not what was learned from the activity itself.

**R4: Affective Memories of Science**

The students exhibited various emotions as they shared their stories of science. While sharing their early science memories, the students appeared animated and happy. The students were eager to share and they frequently talked over each other as they shared their personal experiences. When the discussions involved the hands-on science activities in later elementary school, the students remained quite animated in their discussion.

As the topic of the discussion moved toward their present science experiences, the demeanor of some students and the tone of the conversation changed. Some formerly wistful and vibrant looks began to turn into expressions of boredom and disinterest. Several students complained about what they perceived as a redundancy of topics covered in school science.

Other students became more serious as their talk moved closer to their present day school science. These students talked about enjoying science and the feelings of accomplishment they got from understanding a concept. During this discussion about later elementary school science was the first time any student related the concept of being smart to understanding science.

*I think science was one of my favorite subjects (Ben); we didn’t learn much, we just did it. (Oliver) The experiments are better than the learning part. (Eddie) Well, I probably learned stuff but it’s didn’t seem like it (Oliver)....but I liked the*
experiments we did. It was more direct learning. (Eddie) You were actually doing it; it was more about discussion of what you did and less of the outcome. (Ben)

I had a really smart partner and she would like try to explain these things to me and I would totally like, over my head and by the end, I was like....oh my god, I got that! Like I actually knew how to do the gears on it. (Izzy)

I felt special, because I, like, we didn’t use like batteries or electricity or anything, we used the sun...It made me feel good, because scientists found out a way to use the sun’s energy... (Katie)

I feel amazed by it because as you get older and you’re doing school or college, and you’re doing a project, but it’s the same project, your group does it one way and it’s interesting to see how all the other groups are doing it and to see that to put the solar cars, this is the example I’m using, for as your group does it it’s interesting to see how all the other groups do it, and especially with the bridges, depending on which type you pick and if it works or not and if there’s not a set way, if there is a better way or if there’s not a better way. And it’s just interesting to see how just everything happened and how people do it, so I think it’s great. (Caitlyn)

We did volcanoes before too, but I remember it was more like, “magma comes through the earth” it wasn’t, like, convergent boundaries and all that, it was just.....lava. (Alexa)

I think it (high school science) would be like, dissecting things...and that’s kind of gross. (Kourtney)

It gets really annoying because we repeat stuff a lot, it’s like, we already learned this (Alexa)...Yea, well usually we do repeat it, but....you get more details the next grade. (Lexi)

**R5: Structure of School Science**

While discussing their prior experiences with science the students seemed to place a great deal of importance on when in the past they did a specific science activity. To the students it seems that science is organized by grade level, not by topic or overarching question. Several times during interviews several students almost argued about in what specific grade they engaged in a particular activity. It seemed like when the activity
occurred in the students’ schooling was more noteworthy than what the activity was or what they learned as a result of the activity.

We learned a lot about the solar system in 5th grade…(Caitlyn)

...building a paper-mache volcano in second grade... (Nick)

It was fourth grade definitely we learned about weather... cumulus clouds... (Alexa)

In fourth grade we did that thing with animals. (Lexi)

I remember in first grade, we were making butter... (Chris)

In second grade we had to make these dinosaurs out of dough ... (Alexa)

In either first grade or kindergarten, I’m pretty sure it was first grade, we had a science lab in that school. (David)

We learned about them(rocks) before in fourth grade (Alexa)... third grade (Lexi)... and fourth grade (Danielle). It was both (Lexi). No, it was fourth grade definitely because I remember scratching it (the rocks). (Alexa)

The thing that I remember, that I thought was of any importance would be like 5th grade, because we learned like space and stuff, because I thought actually that would maybe affect me. (Oliver)

**P: The Class’ Progressive Story**

Imagining the future is the next step in the process of *currere*. Thinking about the future is not something foreign to students in middle school (Batchelor, 2006). Children are often asked what they want to do when they grow up. Children imagine themselves older, stronger, or famous as they entertain ideas about their futures. To prompt the students’ thoughts about their future relationship with science I questioned the students about both high school science and about science further off in their futures. I was interested to find out the place they imagine for science in their future lives.
P1: Science as a Career Opportunity

When contemplating the future, the students talked about the role of science in their potential careers. It seems that the students viewed school science as a way to help them decide what profession to eventually pursue. Some students considered school science a useful tool to help determine the students’ talents and interests. In this way, the students see science as beneficial toward making decisions about future coursework or potential careers.

"It’s probably going to help us in our future jobs, you know, like we might become an engineer, or like we might become geometers." (Sam)

"Like knowing all this stuff might help me decide what to do." (Eddie)

"It helps decide what you like and what you don’t like." (Oliver)

"I think it will be useful in the future, like, uh, the life science, like if we’d ever be working in any agricultural jobs or.... If you’re good at science, if you’re educated well in science you’ll be good at many more occupations." (David)

"It helps in the field where you want to get a job." (Caitlyn)

"Um.....We’re.......I’m definitely going to be in a job that includes science with robots or something like that,....and, like David said, with the technology increasing and needing to know how the technology works to be able to run... pretty much, your job." (Len)

"I think school teaches you a lot if you’re in science in school. I think it teaches you about life science and not life science and it kind of helps you pick what you want to do when you’re older." (Caitlyn)

"I think school gives you a basic knowledge of all the different fields so you can pick which one you want to learn in depth." (Allison)

In this discussion the students began to acknowledge the wide range of career possibilities that require knowledge in science. The students also seemed to equate doing well in science with more potential options for future careers. The students had a positive
outlook about the role that science would play in helping them determine their career possibilities. The students did not indicate that any careers might be closed to them because of a lack of science knowledge.

P2: Science I’d Like to Do

The high school science curriculum in the district in which the students attend school follows a traditional biology-chemistry-physics track (Ewald et al., 2003; Fensham, 2002; Hurd, 1983, 1991; Lederman, 2001). The high school students in this district also have the opportunity to take advanced placement classes in biology, chemistry, physics, and environmental science. Most of the students interviewed readily spoke about the type of science they hoped to learn in the high school or beyond. They also seemed to have an idea of what they thought the class would be like. The students’ comments suggest that they felt academically capable to pursue any type of science in which they had an interest.

*Chemical reactions, I want to learn chemistry actually...that would be pretty sweet. (Ben)*

*I don’t know, kind of like physics.... (Sam)*

*Physics would be pretty cool. (Oliver)*

*I don’t know I haven’t really thought about that...um....architecture would be fun I guess. (Nate)*

*I like astronomy, and even though I am afraid of blood, I still like to learn about anatomy. (Danielle)*

*Physics, chemistry... (David)*

*Definitely chemistry, because it’s kind of fun seeing what happens, like David said, with chemical reactions. (Len)*
Space science…..a little bit of earth science. I don’t like biology. It’s kind of just weird. I mean, all I need to know about how my body works is how I eat and how I go to the bathroom. (Nick)

I’d like to do either astronomy or like, particle physics. That’s….I’ve just got interested in that. (David)

I like space science. I do like biology and I like anatomy and things like that. (Chris)

I like rocket science, that kind of stuff, and the chemicals. (Kourtney)

Definitely chemistry… (Ben)

I’d like to learn more about the environment and all the animals that live in it now. (Allison)

I’d like to learn more about stuff in the medical field and just, like, different ways that you can help people and more about medicine and other stuff. (Lea)

I want to find out how when an earthquake is about to happen, how the cats and dogs know how to sense that it’s happening. (Caitlyn)

Yea, I like learning about certain things with the earth, just like, it’s really interesting because, just, who would have ever thought…. (Allison)

I’d like to learn about, experiments with chemicals. (Kourtney)

I like astronomy, and even though I am afraid of blood, I still like to learn about anatomy….(Danielle)

I’d like to learn space science. That would be pretty cool, how the universe works and about different galaxies and stuff, like the Milky Way, more about the Milky Way. (Nick)

I think… I think I like it (space) because it’s kind of unknown to me, and volcanoes and earthquakes, I kind of get the feel for what’s going to happen but with space I can’t really look ahead to what’s going to happen, what will or what has happened…. It’s kind of that unknown factor that kind of draws my interest. (Chris)

Umm, uh, I don’t know. I like rockets a lot. (Nate)

I think we should learn about the sun…and….astronomy. (Alexa)
I’d like to learn about plants, because there’s this one tree, that can spread over several acres and I think that’s kind of cool. (Danielle)

The students communicated a wide range of science topics that they would be interested to learn in the future. Many students mentioned wanting to study chemistry and physics, classes which these students will have the opportunity to take at the district high school. Several students, though, mentioned being interested in learning more about space and astronomy, which they would not have the opportunity to learn about until college.

A: The Intersection of Analytic Narratives

Pinar (1975) suggested that to engage in the analytical one should “describe the biographic present, exclusive of the past and future, but inclusive of responses to them” (p. 5). In the present is where the class’ narrative and my personal narrative merge. For the eight weeks during which I interacted with the students in their science class and through my observations, interactions, and the students’ focus group interviews, our science stories intertwined. When I was not with the students, I was often contemplating their life stories and the role that science played in those stories. When the students were not in my presence, many of them paid more attention to the experiences of science in their lives, as evidenced by informal conversations with students before and after class. As it occurred in our reality, so too will our narratives combine at this juncture.

The Classroom

On the first day of my classroom observations I was introduced by the classroom teacher and I explained to the students that I was a doctoral student and I was going to be
in their classroom for the remainder of the school year. I shared that I was interested in talking with them about their experience of science. Most students seemed to accept that explanation without much thought. One student mentioned that he had a parent who had graduated from my institution, and another student indicated that she wanted to get a doctoral degree. Otherwise the students did not comment about my being in the classroom, although I noticed them occasionally sneaking glances at me.

I was walking around and looking at the work they were doing and they didn’t say much or even look at me for the most part. They basically ignored that I was there. (KSC notes- Day 1)

For the next eight days, I conducted observations from my seat or by walking around the classroom when appropriate.

One of the first things I learned from being in the science classroom at BMS was that my research wasn’t going to go exactly as planned. Thankfully, narrative research allows for this and encourages the methods to follow the story, not the other way around. I quickly learned that my initial research design of limiting my research to the stories of just a few students in the classroom would not be feasible for me, nor would it accurately represent the currere of a middle school science class. I quickly realized that all of the students in this class were “information rich” and that in limiting my study to just a few students, I would be skewing the science story that existed in this classroom. After a day or two of observations, I decided that I would interview the entire class in focus groups, thereby capturing the science story of this class.

I also realized that my position as the researcher in this narrative inquiry presented difficulties that I needed to work out myself. I had previously been in classrooms as a researcher, but the research in which I was involved revolved around the
teacher or how the students responded to the teacher, the materials, or the learning. Since this research involved drawing out the students’ stories, I had to keep reminding myself that I was in the classroom to listen to the students. After years in the classroom, I was used to hearing and listening to the teacher’s voice; this time I had to shut out the teacher’s voice and devote my focused attention to the students. As a classroom teacher, I was used to keeping students on task; in this situation, I was required to observe the students, as they were. I had to learn to suspend judgments, suggestions, and former habits. I had to push myself to be completely in the classroom: with the students, for the students, and about the students.

I realized early on how much I was conditioned to listen to the teacher. Since I had previously taught in a seventh grade science classroom, I was interested in the subject matter and how this teacher approached it. It was difficult at first for me to pull myself away from the teacher and focus on the students. It would be several days before I truly understood what I was looking for and looking at. As a teacher, I often observed my students mostly to see how they were reacting to me or to the topic at hand. Based on their actions, I would react accordingly: if they seemed bored I might get more animated; if they were talking to another student, I might walk toward their seat; if they seemed engaged I might ask questions. I was familiar with looking at students to determine my next action. I was not familiar with watching students for the sake of understanding their place in the science classroom, nor was I familiar with merely observing students’ so-called misbehaviors (talking to a friend, doodling, visiting unauthorized websites) in an effort to gain insight into the student’s place in the classroom. This habit of listening to
and looking at the teacher and making value judgments of the teacher and students is one with which I would struggle during my entire experience.

By the end of my first day in this classroom, I understood that these students were good at “doing school”, described by Pope (2010) as “going through the motions, slogging through the school day, turning in the work, often getting good grades, but with very little attempt to learn the material in depth or master the skills and knowledge of the subject areas” (p. 4). They knew how to behave, how to answer questions, they could do what they needed to be successful in the classroom. The students came into the classroom in a relatively orderly fashion and went right to their seats. They talked to each other as they were coming in the door, but they weren’t overly loud or distracting to others who were having conversations.

_The students maintain a definite level of volume during class, lower than in the beginning of class, but they never seem to go over a definite boundary._ (KSC notes – Day 3)

They became quiet when the teacher asked them and they did their work as assigned.

Most discipline that I witnessed from the teacher revolved around noise levels or getting started with an assignment.

The students were comfortable enough in this classroom to joke with the teacher and with each other. When the students came into the class, they often shared something with the teacher, like the outcome of a sporting event or plans for the weekend. The teacher in turn knew something personal about each student and would often ask them about hobbies or out of class activities. In this way the classroom seemed to be a comfortable setting for the students.
Through my observations and interactions with the students, I quickly became part of the routine that was science class. While the content covered each day might be different, overall the rhythm of the class over several weeks stayed pretty much the same: an introduction to a new topic, several days spent reading and doing work from the textbook, one or two lab types of activities, and another activity that involved gathering data on the internet. The class seemed to have somewhat of a complacent attitude toward science.

*Things get repeated over and over in this class, but the students really depend on what’s just beneath the surface to answer a question. They don’t seem to want to, try to, or consider going much deeper than that. It does really start to seem like school is just a place for them to wait until they are old enough to do something worthwhile.* (KSC notes – Day 35)

These students were grounded in their present. School makes up a large part of their current reality, and their discussion topics reflected this. For these students, science in the present consisted largely of whatever topic was currently being discussed in class. Most of the interview time was spent in discussion about the present. While the students spoke positively about their early memories of science and were somewhat objective about their future experiences of science, the students seemed more likely to critique their present experiences of science. They were very open about their feelings about their present experiences of science.

**A1: Science I Do Outside of School**

The students were asked about the science in which they engaged outside of school. More males than females shared that they participate in science activities outside of school. It is interesting that while the males would offer activities they did after school
as science, they didn’t want themselves to be labeled as doing science outside of school.

The students who did science outside of school, whether they thought of it as science or not, considered outside-of-school science very different from inside of school science.

_I don’t do….well, I guess I do….I guess it’s scientific, it’s more like experiments._
(Oliver)

_I don’t do anything in school and I don’t do anything outside of school._ (Ben)

_Does blowing stuff up count?_ (Sam)  _Like rockets and stuff…(Oliver)...rockets and flamethrowers... (Eddie)...like mixing baking soda with vinegar ...(Oliver)...with bottles and they go....(makes an explosion noise). (Eddie)_Well, it’s all about chemical reactions. (Sam)  _We don’t do any of the scientific stuff... (Eddie) ....like we do in school._ (Oliver)  _You just shake it and throw it._ (Sam)

_Well, sometimes, like some of the things I do, I don’t think about science but a lot of things I actually chart, and, like, graph of plants and stuff._ (David)

_Like, I do experiments at my house ...chemical reactions, like baking soda and vinegar....and......let’s see, what else.... First of all, because it’s fun to, like, explode something. And just, like, to see if I could get, like, what works with what, like.....more baking soda,... more vinegar._ (David)

_Mostly anything that flies or explodes, I’ve probably played with it._ (Len)

_We burnt, ah, slugs and worms and ants with ...um .....a magnifying glass._ (Izzy)

_I don’t know. I think once I built a rocket outside of school. Sometimes I just.....I don’t know....do stuff._ (Nate)

The students had a difficult time coming up with science they did outside of school. A few of the students seemed somewhat embarrassed to admit some of the activities in which they engaged. The conversations about this during the focus group interviews were very short.
A2: Relevance of Science Class Topics

During the quarter in which the interviews took place, the students were learning earth science in science class. Classroom topics covered during this quarter included: earthquakes, volcanoes, rocks and minerals, and weather. The students had learned about these topics in an earlier grade and although they admitted that they were currently learning new vocabulary and concepts related to these topics, the students often commented that they felt that the information they were learning was redundant. The students questioned the relevance of what they were learning, especially during the topics of earthquakes and volcanoes. The section of the country in which these students live is not prone to earthquakes and does not have active volcanoes.

*I mean, I’m being honest, it’s important, but it’s not….I don’t think it’s ever going to affect me.* (Chris)

*It’s not majorly important but it is important.* (Danielle)

*You’re not going to go to a volcano and say, hey, look, the lava is coming up a pipe.* (Nick)  *Yea, the lava’s coming up a pipe, the pressure is released.* (Chris)  *All you’re going to know is just to run.* (Nick)

*If you lived near volcanoes…..* (Danielle)*…but still it’s not going to help you just because it’s there, it’s not going to help you because you’re living there…. Just because “well this is a hot spot” and….it’s not going to help you if it’s just going to explode and kill you all.* (Alexa)

*Because we’re in Ohio, it’s kind of not really that important, but if we moved somewhere, like California or LA…* (Nick)

*Well, I guess it depends on what you want to know, say I might be more interested in other stuff than volcanoes but I hope that people who are interested in volcanoes get a job later in life.* (Lea)

*Yea, I think that will better prepare you for like, if there was a place where you were at where there was a volcano that erupted, you would know what to do and how to protect yourself.* (Allison)
Volcanoes…..not so much… (Alexa)

Because I live in Ohio and there’s not really like any earthquakes. (Sam)

It, like, what we just learned, it makes me think more about it, like, instead of just looking at a rock, it would make me think about it more… and like, think of how it’s made. (Kourtney)

While the students questioned their need to learn the content throughout the semester, at the same time they did acknowledge that they needed to know the information for state testing purposes. Even though the students said that they had learned the information in an earlier grade, they did not appear to know many of the concepts or much of the vocabulary that went with these studies. Much of what the students were taught about these earth science topics was vocabulary and factual information.

Several times during this quarter the teacher arranged for use of school laptops for the students during class. The students were very comfortable using the internet to look up information. When searching for information, most students would simply go to the Google homepage and type in an entire question, rather than just using key words. When this did not yield the answer the students were expecting, they would often appear stumped or ask the teacher for help. The students did not bother with spelling correctly while on the computer and they relied completely on spell check. Computer writing in which the students engaged involved more of a ‘stream of consciousness’ writing rather than writing in paragraph form.

The tables were self-segregated by gender so it was relatively easy for me to notice differences between the actions of the males and females. When working on PowerPoint activities, the boys seemed to focus on getting the project done. Often one
male partner would look up information in the book while the other worked on putting the information on slides. The boys would first set up the slides to be a certain color and style, then they would work on adding the information to the slides. The girls’ groups tended to quickly complete the information on the slides then spend more time formatting the color and design of the slides. The males seemed to concentrate more on getting the job done, while the females seemed to need the directions repeated several times and often asked for clarification.

When looking up information though the students often focused more on how the information related to the assignment rather than how it might relate to real life. With projects what seemed to be important to these students was finishing. (KSC notes – Day 23)

A3: Usefulness of School Science

The students often debated about the overall usefulness of the kind of science they were taught in school. The students even questioned this during class, occasionally asking the teacher why they needed to know specific information or when they ever would use the content they were learning. The students did admit to me that some content they learned seemed useful, but they attributed most of this usefulness as related to some future event or profession.

I think it will be useful in the future, like, ah, the life science, like if we’d ever be working in any agricultural jobs or ….(David)

It’s better to understand the things that you use in like everyday life (Eddie).

The rest is just not, like it’s not going to help us in any way. It wouldn’t affect me…..it’s just like more knowledge. (Oliver)

But there’s some labs that do actually help things…(Sam)…like the one where we did the seven things, like we actually experimented with the seven minerals…
(Oliver) and we had to figure out which one was which, using color streak... (Ben) Yea, that was a good lab... because we were actually going through all the steps, actually applying what we were learning ...(Eddie)

Without science how would we ever be able to like..... do stuff.... how would we ever go to the moon, outer space travel would be impossible......and we help the environment and stuff, there’s more environmental stuff....(Sam)

... for knowing the way the earth is heading. (Eddie)

A4: How I Like to Learn Science

The students had very specific ideas about the way they liked to learn science.

The students stated that they enjoyed hands-on activities the most. They do not enjoy reading the textbook and some students felt like it was a waste of time.

Like I think class now, it’s so slow-paced, like we have way too much time...twenty minutes to read... a paragraph. Not many of them read, like honestly, if you really think about it, not many people actually read in detail. (Oliver)

Um.....say you like build a replica of a volcano, and then when you’re all done, you activate it or however you want to do that, and see it erupt. That would be cool. (David)

I think it would be cool to like make actual projects, in class, like making the volcano. (Alexa)

(I like) Lots of experiments, I liked all the experiments in my other schools, they were fun. (Nate)

Fun is like seeing results of the experiments or... (David) ...working with your hands....(Len) Yea, and um, looking at the progress of an experiment over time. (David)

Like I think I learn more from doing it.... Oliver

I like projects because it’s more interacting... easier to pay attention, I guess. (Nate)

I don’t think we should do any, like, pointless labs, like only do a lab if it helps.... (Sam) Like try to find the density of a rock... (Ben) ... because it already says that
in our book. (Sam) Because it took, like, a really long time and we could have been doing other stuff. (Eddie) We could have taken that class time to get up on another section. (Oliver)

Like some science things, I like don’t get, but some like the hands-on projects, I understand a lot and they’re fun. (Kourtney)

(It was fun)... because it was more like, hands-on and it wasn’t, like, reading from a textbook. (Gina)

I really like creating something, or see how something works, just playing around with something science-y....(Nick) I would have to agree, I mean, I like science as a subject and I like doing science projects. (Dan)

The students did not carry backpacks in school, so they carried books with them to the class. When the students came into the classroom, they would sit the books on the floor next to their chairs. Many of the students brought pleasure reading books to class. Some students brought adult fiction books while others brought young adult fiction books like Harry Potter or Twilight. Many of the students carried pleasure reading books that were at least 300 pages long with no pictures. In contrast, I noticed that the students’ science books were less than 100 pages, written in a font several points larger than the font in the pleasure reading books, and filled with full-colored pictures that often took up full pages. This contrast in books made it appear that the science content was very watered-down for these students who were used to consuming much more detailed information.

I sometimes wonder how much they could learn by themselves with a book. I almost think that given a day or two, these kids could learn what we are spending 8 weeks learning. (KSC notes – Day 18)
A5: Characteristics of Science

During the discussion about the present the students discussed several characteristics of science. The students often mentioned that they thought that science is everywhere, even though few of students admitted to doing science outside of school. The students frequently commented on the importance of science, especially as it relates to technological and medical advances. The students also discussed the overwhelming amount of information that is labeled science. I divided the data in this section into three subcategories based on theme: (a) science is everywhere, (b) science is important, and (c) science is a large body of information.

A5a. Science is everywhere.

Well, I mean, you kind of learn science every day. You have science every day in your life. (Lea)

Even like...my next door neighbor, he’s a scientist, and a science teacher too. He told me one time “even picking out your clothes is science.” (Lea)

Also, just you read it in books, you learn so much from just reading one single book, even if it’s science fiction, it doesn’t matter. (Lea)

If you like hiking, you’ll find a lot of life science. You’ll find a creek, you’ll find bridges, you’ll find plants, you’ll find animals....and you can find it even in houses, ’cause if you want to water plants with your mom or something.... (Caitlyn)

And I know, like, my brother, he’s, like, taught me some things,... And he’s taught me some things about the mind and stuff.....I don’t remember all of them. (Lea)

And I even remember since I could read, like, you learn stuff through reading, even when I was in preschool and stuff. (Caitlyn)

Just from the people around you even and you hear it on TV, you read it...(Lea) ... and from pictures you wonder “what is this” and people teach you. (Caitlyn) I don’t know but science is everywhere. It impacts you every day, wherever you are; there’s always science somewhere. (Caitlyn)
Probably because everything you do is technically science….and if you’re working somewhere like, I don’t know, um, let’s just use, the airport, you’re probably figuring out and graphing which pretty much includes all math, which is science, um, how well the flights went, if they took off on time, I don’t know…. (Len)

Because science is humans and humans are part of science, I mean this interaction and everything just impacts you, just from the study of it. (Lea)

Isn’t science in everything? (Katie) So in everything we do, everything we do is considered science. Even just, like, planting flowers is science. (Izzy)

Yea, you see science literally everywhere. Basically everything outside and inside of school can be put into the category of science because of all the technology it uses. Anything on earth and out of earth is science. Yeah, so it’s a very broad subject. (Chris)

Trees are science, literally everything is science. The building is science because architecture is science. (Nick)

Sports are science. (Chris) Yea. (Nick). You can label that as science because of trajectory and angles. (Chris)

You use it almost every day, like Leasaid, you just need to know about it so that you can ...use it in everyday life. (Allison)

A5b. Science is important.

(Science is important) because then we wouldn’t know any cures… (Izzy)…because it’s like, everything (Gina). We’d like, be dead by now, probably…. (Katie)

Because like it involves a lot of things you use everyday. (Gina) (Science is) very important (Chris) …because science is everywhere. (Nick). If we didn’t have science I wouldn’t be doing any of this right now. (Chris) We would just be blobs. (Nick)

...because science is basically everything we do in our days. (Danielle) There’s really nothing that you can’t link to science, because everything is a science, even if you’re not learning it as a class in science, it’s still science. (Alexa)

Because without science, we wouldn’t know very much about the world or space. And since we know about the world and space, we can create things which take science and we can become more advanced. (David)
A5c. Science is a large body of information.

We learn more and more everyday about science. (Nate)

Science, it’s everyday life, but also it’s the study of the universe, so a lot of the stuff we know came from just the general curiosity of the people today and all the way before that so it seems like, they wanted to know just from curiosity and wanting to know so, then they helped us today so ....I guess that we don’t really need to know more stuff, but it helps. (Lea)

I mean it would be great to learn everything about science, but it’s kind of impossible in one lifetime. (Lea)

I also like science because you get to learn new things every day, and you get to synthesize it, like the general curiosity of everyone where you get to learn new things and discover things. (Lea)

I guess it would be a little more advanced, because we learn more and more everyday about science. (Nate)

I think they (people) ignore science at all costs. (Izzy) They think it’s like, too hard to learn....(Gina) because it’s just so much....memorizing...and like the periodic table and..... (Katie) and there’s just so much stuff....(Gina)

There’s like a bunch of different things that are considered science.....so um, so like people think it’s a lot about memorization.....I don’t know. (Katie)

A6: Family impact on science. The role of their family was important to the class’ discussions of science. Family played a major role in students’ early memories of science. Family members were also important to students’ present understandings of science. Many students mentioned a family member who was involved in science and the effect of that on the student himself. The students greatly valued their relationships with their family members.

I helped my sister with her science project for school. I can’t remember what it was, she was asking me questions though... She was asking me to do....something. I wasn’t really paying attention. (Alexa)

But it’s cool because my mom was taking a biology class in her college thing so like her and I could talk about it and it was cool just being able to know all of it.
(Sam). Just like know what your parents are learning too. (Oliver)

My whole family is into science, ‘cause, like, my dad’s a doctor, and my sister, she’s like going to be a biologist, same with my brother, so it’s, like, my whole family is into science. (Oliver)

Well, my brother is going to college for engineering...and he likes science a lot also, and it affects his life a lot and my whole family uses a lot of technology a lot, so.....(Nate)

My sister took biology and she had to dissect a baby piglet. (Katie)

My dad....for medical school, he had to dissect a dead corpse. (Izzy)

Oh, oh, oh, ....I’m very proud of my family because we used to have three trash cans and now we have one trash can, and like two recycling bins. (Katie)

My dad’s a doctor, so he’s always talking about like, stuff like cancer, and like, stuff like that. (Izzy)

Let’s say you want to go to Hawaii for a family trip; if you didn’t know what a volcano was, let’s just say if you didn’t think volcanoes were important you didn’t learn a thing about them, you go to Hawaii and see this tall mountain,... (Caitlyn)

My sister, she’s in second grade, she does a lot of experiments, like she does stuff with butterflies and stuff like that and she tells me about that. (Kourtney)

Well, like I said, my mom’s a science teacher so like she’s always telling us different things that she just learned and like, give us more knowledge. (Allison)

I think, personally, it depends on how your family sees it. And what field your family’s in. If they’re in engineering or architecture or medical field or just daily or something, or if they’re in a science field, it depends on how each of the families sees it and how you adapt it. (Caitlyn)

Yea, my family was planning on doing it (building rockets); I thought it was really fun, so yea. (Allison)

Well, my sister wants to be a scientist, so like, she knows a lot more about it even though she’s in second grade, more than, like me...... (Kourtney)
The End of the Present

During the time I spent in the classroom I often left frustrated. I was disturbed with the lack of engagement between the students and the content. I wondered if I had missed this while I was teaching in my own seventh and eighth science classroom. I was also frustrated with not knowing how to affect change. The students in this classroom were bright, intelligent, and creative, and it seemed to me that they were completely bored in the science classroom.

While I was in the classroom, the students were involved in a unit on earth science. They asked daily why it was important for them to learn about volcanoes. They did not see any of the information they were learning as being relevant to their life, either now or in the future. They had learned something about volcanoes in an earlier grade; the students seemed to view some of what they were learning as redundant, and the rest of the (more in-depth) material as useless. Several students also indicated that if someone wanted to do a job that involved volcanoes that she could learn what she needed to know when she was in college. It was difficult for me to explain to the students why it was important for them to know this information, as I began to question the logic myself. As stated by Noddings (2005), “Why do we gotta study this stuff?” is a question that deserves an answer. It is a clear sign that the need we have inferred for students is not one that they are expressing or feeling” (p. 154).

I also wondered about the learning outcome some of the laboratory activities in which the students engaged. Most of the laboratory activities were directly out of the textbook, but some of them seemed so far-fetched, that it was difficult to make sense of their purpose.
To me, many of the experiments in the book are so contrived that it is hard for me to find the connection to what they are actually supposed to represent. I wonder if when I taught the kids made the connection themselves or if I made the connection for them. It seems that the students are more interested in the doing than the thinking sometimes and I think it’s hard for them to relate some of the lab activity to the actual event. (KSC notes – Day 19)

All the while, I continued to see bright, energetic students respond in zombie-like fashion to a subject matter that was supposed to entice and engage them.

The end of my research was the end of the school year for the students. The students were extremely restless for the last several days of my research, as the weather had turned warm and sunny and they would soon be done with school. The students seemed anxious to be out of the classroom and involved in whatever activities would occupy them for the summer.

The classroom teacher and I decided that I would bring in pizza, snacks, and cupcakes for the students as a thank you for helping me with my research. The students had their lunch period immediately following science class and the classroom teacher offered his room for this gathering. Although we were still technically in the classroom, it was a great opportunity to see the students be social with one another and with the teacher and me. The teacher gave a student permission to hook up his ipod to the classroom speakers and the lunch turned into a dance party. The students talked and laughed, ate and danced, somewhat free from the typical restrictions placed on them by the classroom.

It was a bittersweet ending for me. Having the opportunity to be in a middle school classroom again reminded me of how much I enjoy the energy of early adolescent students. I was sorry to end my relationship with these students. I was excited about the
narrative experience of science experiences the students had shared with me; I was somewhat disturbed by my realization that these students seemed bored by classroom science; and I was nervous about beginning my data analysis and dissertation. I left this classroom believing that many of these students could have successful careers in science, but worried that many of them would be turned off, shut out, or pushed out of STEM areas of study.

**Summary**

The students shared their experiences of science and I categorized the data by themes under three overarching ideas related to *currere*: regressive, progressive, and analytical. The students were very excited to share their early memories of science, which began with memories from when some were as young as three or four up to memories of science from fifth and sixth grade. When students were sharing memories from early elementary school, the joy in these memories was apparent on their faces. Most of the memories related to life cycle observations, particularly with butterflies and young chickens. As the students shared memories of science throughout their elementary years, they focused most on hands-on activities and experiments.

The students shared their ideas about how science would influence their future. The students considered the science they are learning now to be helpful toward a future career. Many students indicated that taking science in secondary school helps one to decide in what field they are interested and in what they are talented. The students also readily shared science classes that they are interested in taking in the future.

When asked about their present experiences of science, the students critiqued the science they were learning and had learned in the recent past. The overall topic in their
fourth quarter science class was earth science, and during the quarter the students learned about earthquakes and volcanoes, rocks and minerals, and weather. The students mentioned that learning about earthquakes and volcanoes did not have much relevance to their daily lives. When talking about the present, the students often included the influence of family members. Parents, siblings, and others in their family being involved in science, either through a career, studies, or interest, made an impact on these students’ experience of science. While discussing the present, the students also often mentioned the idea that science is everywhere. The students cited this as a reason that science is important. They also indicated that the field of science is very large, that new information is constantly being discovered, and that the amount of information included under the umbrella of science sometimes discourages people from being interested in science.
CHAPTER V
THE SYNTHEtical: DISCUSSION AND IMPLICATIONS

In an era where scientific issues such as genetic modification of foods, global warming and others continually surface as the political and moral dilemmas confronting society, the disengagement or disenchantment of our youth with science may increase the separation that currently exists between science and society. Such a consequence is one that an advanced industrial society can ill afford to pay, both at the individual level where it might lead to the rejection of sound scientific advice, or at the societal level where limitations may be imposed on scientific research that could have potentially beneficial outcomes for humanity. (Osborne & Collins, 2001 p. 464)

Class’ Synthetical

The final stage of the process of currere is the synthetical. In this stage one is encouraged to look at the past, future, and present together to see how they work together to bring one to where he is and towards where one wants to go. About the synthetical Pinar (1975) wrote

We can understand our present in the way that allows us to move on, more learned, more evolved than before. Perhaps then we can grasp again the significance of academic studies and the potential contributions they can make to our lifetime. (p. 15)

Early in the experience I realized that the students were not in a position to be engaged in synthetical thinking as it relates to the concept of currere. I conducted two follow-up interviews toward the end of my research where I asked students to elaborate more on some of the answers they had given during the focus groups in an effort to approach synthetical thinking. These follow-up interviews ended quickly with a lot of “I
don’t knows” and frustration. I believe that the students were new to having someone interested in their personal opinions about science, particularly within the setting of school. I also know that the students had not previously engaged in currere, which required some deeper thinking and analysis with which the students had no practice. Perhaps the students were developmentally not yet ready to process the type of abstract thinking required by the synthetical stage of currere. I believe that with practice the students would be able to engage in the synthetical and complete the cycle of currere. This process, though, could lead to further frustration if the experience did not lead to effective change or to the students’ currere being seriously considered.

Since the students in this class were not able to engage in the synthetical, the process elaborated in this section is comprised of the synthetical intersection of the experiences of both the class and myself. I believe that this is valuable as well because I have the skill and understanding to relate our experiences to available research and to make this study known through writing and publication. This then allows the students’ experience with currere to have impact beyond just their personal experience with the process.

Summary of This Study

The purpose of this research was to uncover the curriculum of middle school science students using the framework currere. The qualitative method of case study was used in this research to gain access to middle school students’ experience of science. The study took place during the fourth quarter of the school year with a fourth period science class at Brookwood Middle School. I spent each day of this quarter in the science
classroom with this particular group of students. I made observations in the classroom to provide a thick description of the setting and the research participants.

The student participants were interviewed as small focus groups, with the exception of two students who were interviewed individually due to scheduling conflicts. I questioned the students using a semi-structured interview protocol following the process of *currere*. This allowed for all students to be asked the same general questions but it allowed for the conversations to go where they wanted to go.

This research is relevant because the large number of students who drop out of the STEM pipeline at some point in their academic career is of concern to many (Blickenstaff, 2005). While much research has focused on why students drop out of these majors in college, researchers are beginning to place more emphasis on students at the secondary level and the choices they make in high school regarding course selection. It is also important to recognize that academic course choices made in middle school can make it easier or much more difficult for a student to pursue STEM studies in his future.

The overall research question, “how is curriculum lived by a middle school science class” was broken into three subquestions, based on the framework of *currere*.

**RQ1:** What lived experiences does a middle school science class bring to the science classroom?

**RQ2:** What future relationship with science does a middle school class foresee?

**RQ3:** What are the everyday experiences of a middle school science class?

Following the data collection I coded and sorted the data by themes within the three subquestions listed above.
Lived Experiences of a Middle School Class

In part, the solution here lies in asking teachers to think more carefully about pupils' prior experiences and explicate how any topic they introduce will be different and build upon their previous knowledge. (Osborne and Collins, 2001, p. 453)

The class shared with me a rich history of early science experiences. Many in the class were able to recall science activities they completed prior to beginning school. When the students conversed about these activities, they were excited, as if they were sharing fond memories. Maltese and Tai (2010) proposed that “with a high percentage of both genders reporting interest in science prior to entering high school or even middle school, it may be important to instead center efforts on engaging young children in science” (p. 681). Most of the early science activities in which these students were involved consisted of observation or naming things, the students weren’t engaging in hands-on or inquiry activities. The class remembers these early science activities as an introduction to the world around them and to science processes.

The parents of the students played a large role in the class’ earliest memories of science. The class’ recollections seemed tightly linked to positive feelings of sharing time with a parent and being involved in something in which the parent was interested. The early science recollections of many of the students were those of science activities with their parents, not activities done in school. In a report by Maltese and Tai (2010) a majority of the graduate science students and scientists they interviewed reported that their interest in science began before middle school and was encouraged by science activities done at home.
The class’ elementary school science memories were full of recollections about hands-on science activities. The students particularly seemed to enjoy activities which involved some competition among classmates. During discussion about these competitions, the class seemed to focus on the activity itself and not the competition, but they did recall these competitive science activities being enjoyable.

Turner and Ireson (2010) remarked that primary students disliked activities such as “difficult tasks, sitting down tasks, listening, writing” (p. 130). The class in this research did not mention these sedentary types of activities when recollecting the past. It is not known whether this is because the class did not experience these types of activities or they merely chose not to remember them because they were not interesting enough to recall.

The procedure of classroom science activities seemed to be very important to the class. The students didn’t seem to recall much about the outcomes of the activities. Jeong, Songer, and Lee (2007) reported in their study that sixth grade students had difficulty connecting the outcome of laboratory activities to larger science concepts. It’s difficult from these data to know whether the class made connections at the time of the actual activity, but what the class chose to recall was the procedure of the experiment rather than any outcomes or connections.

Science taught in elementary school is not often inquiry-based and is frequently centered on following directions (Allen, 2008). The class seemed excited to recite the procedure to me about the various experiments that they did, indicating that the importance was on the directions and not on the experiment itself. Archer et al. (2010) submitted that younger students feel that “interest, application, effort, and
‘concentration’” are more important to being successful in science than intelligence (p. 629). This focus on more scripted science procedures can sometimes lead students, and even teachers, to be uncomfortable with open-ended inquiry because “school science essentially deals with established consensual knowledge which is not open to critical examination or reinterpretation” (Collins & Osborne, 2001, p. 453).

A few students mentioned coming up with their own experiments outside of school and hesitantly labeled these activities as science. Other students played with rockets outside of school yet did not want to call their activities science. These out-of-school science activities in which the students engaged were more inquiry-based types of activities, yet the students did not want to or did not think of them as science. It seemed that the class considered their in-school science activities to be more science-related even though they were less inquiry-based.

The class was very precise about in which grade they did certain activities. It seemed very important for the class to relate specific activities with specific grade levels. Due to content area tests given during specific grades, it is currently important that teachers cover certain topics at certain times, so that classes will have the prior knowledge needed to understand the topics that follow.

In a climate of “high-stakes” assessment where many teachers feel compelled to cover the entire content to maximize their pupils’ chances of success, the experience is too rushed, forcing teachers to use techniques such as “copying”, which are both mentally stultifying and of little educational value (Osborne & Collins, 2001, p. 461). I suggest that perhaps the importance on content alignment filters down to the class through the
teacher’s emphasis and keeps the class focused on what they should be learning and when.

A study from Jeong, Songer, and Lee (2007) reported that sixth grade students lacked skills related to the role of evidence in scientific investigations. The researchers in that study found that the students were not able to make mature decisions about the outcome of scientific investigations and that the poor performance of the students in that study may have been partially due to the fact that the students were from a “disadvantaged urban school district” in which the students experienced “many challenges and barriers to the development of their inquiry abilities” (Jeong, Songer, & Lee, 2007, p. 92). In this current study the class’ memories of science indicated that they also lack scientific investigative skills. It is interesting to note, though, that the environment of this class’ school is rich in resources with mostly all students above poverty level and with well-educated parents. This finding suggests that perhaps investigative and interpretive skills may be more related to students’ developmental level or to teaching techniques than to the amount of resources which a school has.

The class’ overall discussion of past science experiences followed many of the traditional topics and activities taught in schools. The class did report some activities with solar energy and “Barbie bungee jumping”, but these were reported as activities and not long-term studies on topics out of the ordinary. The litany of consistent topics was also evidenced by the fact that these students did not attend the same elementary schools, yet they mostly engaged in the same types of science activities, science content, and science teaching.
Everyday Experience of a Middle School Science Class

Course and content. The class seemed to have a contradictory view of present day science. The class reported that they were often bored by the science they learned in school, while at the same time they described science as important, necessary, and all-encompassing. Both George (2006) and Osborne and Collins (2001) reported that middle school and high school students value science as important and useful to know, while Allen (2008) suggested that the presentation of school science often makes it difficult for students to understand the nature of science.

Similarly, the class described science as “everywhere,” but they had some difficulty describing science in which they were involved outside of school. It is possible that that the class views school science as completely separate from the larger body of science knowledge. Osborne and Collins (2001) suggested that “the link between science and contemporary events is too often ignored, or alternatively, crushed by the weight of an overloaded curriculum” (p. 461).

The class struggled through content about earthquakes and volcanoes, content which they viewed as irrelevant. While Barmby et al. (2010) suggested that students do not make connections between school science and everyday life, they also proposed that students are not often taught how to make these connections. It is difficult to tell if content connections would have made a difference in the class’ views of the earth science topics they studied.

During their study of volcanoes the class was displeased because another science class in their grade with a different teacher created volcanoes to explode using vinegar and baking soda. In the minds of the class in my research, that volcano activity was
much more enjoyable than the in-class learning they had done and the class felt cheated that they did not do the same fun activity. Maltese and Tai (2010) reported that teachers can serve to both turn students on and off of science. No data were taken on the difference in learning between the two classes, but it would be interesting to see if the class who made the volcanoes learned more or less than the class that mainly studied content.

I conducted my research during the last quarter of a school year, a time when many teachers find themselves teaching as much material as possible in order to complete coverage of the grade-level content. This rate of teaching can leave little time for engaging students in hands-on or inquiry activities. Logan and Skamp (2008) reported that “the classroom environments that students ‘disliked’ involved copious amounts of note copying, science topics which were rushed, limited practical science and a lack of student decision-making when there was practical work” (p. 516). The class I observed seemed to then continue this type of superficial approach when completing assignments and projects for the class, seldom applying higher order thinking skills and doing the least work possible.

Although the class emphasized that they liked being involved in hands-on science activities, they did not like to do experiments in which the answer was readily available. The class preferred activities that had a specific purpose or one that had relevance to their daily lives. One experiment that several students found to be boring was from the textbook and involved the students’ determining the hardness of different rocks. If the class had been given a real-life reason for needing or wanting to know this information,
they may have been more engaged in the activity. Once again this shows that student interest in science exists; it is more the pedagogy with which the students have an issue.

**Logistics.** The pace of the class and the type of rote learning in which the students seemed to be involved continue to concern me. The content from the book was typically covered during class. The class sometimes seemed hungry to learn about different topics or to learn topics more in depth than what was available to them in class. There was no opportunity during the time I was in this classroom for students to make any choices about content. In reality choices about science content would not occur for these students until their third or fourth year of high school, and even then, their choices will be limited. Anderson (2002) remarked that inquiry teaching and learning in the classroom is difficult because teachers are encouraged to teach from the text. It seemed to me that science class was sometimes little more than a time-filler.

One student mentioned being interested in seeing the progress of an experiment over time. Although these types of experiments can give students a more realistic opportunity with science, it is often difficult to arrange this type of activity in a science room which houses multiple science classes. In many schools available space is often at a premium and it is often difficult for a teacher to set up an experiment that will not be disturbed during the daily life of school over the course of time.

Much of the class’ school life seemed to revolve around schedule, procedure, and process. This was also true in the science classroom. As with most middle schools, time is highly scheduled and courses orchestrated so that students and faculty can move seamlessly from one class period to the next. Because of this structure science lessons, activities, and experiments have a specific time frame in which they must be completed;
there is typically no opportunity to go over the allotted time of a class period. In a
science class this time limit can lead to a false sense of the way science is conducted.
This sense of schedule seems to rule the student behavior of the science classroom as
well: the students inherently understand how long they can talk when they come into the
room, what in-class talking they can get away with, and how much work they actually
have to do in class. When the class needs to get something done quickly, they can work
quietly and efficiently. Otherwise, science class seems sometimes like social time.

The class’ emphasis on directions and process in experiments and on placing
importance on when activities were done seems to indicate that these things are being
inferred to the students as important. In a typical school day a teacher has a certain
amount of content she is expected to cover. In a classroom with 30 students, it is
imperative that students follow directions. When teachers have a schedule in which their
class is not self-contained; they teach multiple sections of the same class, this order and
organization becomes even more important as the class has a specific time frame during
which they need to complete an activity. If the class does not follow directions, or if
directions are not clear, the activity cannot get done in the space allotted. There is
typically not room in a classroom to store multiple classes science lab set-ups, which
means cleaning up and putting away are an important part of the directions and the
procedure. This emphasis on direction eats into the rest of the class time to be spent on
the actual doing and often leaves little to no time to consider the results of experiments
and even less time to discuss how and why results may differ. Each of these things is
crucial in scientific exploration, yet the process is what the class remembered most.
**Content repetition.** The class often complained that they were learning topics they had already learned in an earlier grade. Osborne and Collins (2001) suggested that “the apparent simple repetition of a topic, which fails to build and develop pupils’ knowledge, and to make its new insights distinctive, has the potential to alienate many pupils from the subject” (p. 462). Even when the class admitted that they were learning new vocabulary or deeper understanding of a topic, they still felt that they were repeating information. Galton, Gray, and Ruddock (1999) suggested that students may feel that they are repeating work that they have already done, not understanding that “a static competence is not enough” (p. 19).

Braund and Driver (2005) also suggested that secondary school teachers often teach science as if they are starting from scratch; that secondary students have little prior knowledge. (While teaching middle school I had a high school science teacher tell me that it didn’t matter what I taught to seventh and eighth grade science students because we [secondary school teachers] have to teach everything over again in high school anyway!) This repetition is not lost on the students especially when teachers do not make connections to students’ prior learning and understanding.

It also interesting to note the difference in reading level between the books the students read for pleasure and the science book the students use in class. The students seem capable of much more in-depth learning based on the higher reading level of their pleasure books. In class the students seem bored when reading from the science text.

Family continued to play a role in the class’ present day experiences of science. These students had siblings and parents actively involved in science through school or work who were willing to share their experience with the students. Bleecker and Jacobs
(2004) reported student achievement in math and science is related to parent education level. One student was particularly excited about learning similar information in seventh grade science to that which his mother was learning in a college introductory biology class. While the science material was a point of connection for the mother and son, it also served to encourage a relationship between the two around a similar interest.

Occasionally students would tell me about seeing a show on TV, usually on a science or history channel, which mentioned something they had learned in class. Students enjoyed making this connection, especially if the program contained vocabulary they could understand due to having learned it in school. This content connection was especially exciting for students if they were able to explain it to a family member. There are multiple possibilities for using media in and out of the classroom to help students find relevance in science content.

The class recognizes the all-encompassing nature of science and how important science is to the future, but in many ways this understanding of science seems to be disconnected from the science they learn in the classroom. Much of the science as it is introduced to students of this grade level is presented as factual, even though there still are many unknowns about earth science. For the most part, the course content seemed to focus on factual information that will be reflected in the statewide tests they will take (Faulkner & Cook, 2006).

**The Class’ Science Future**

The class in this study was extremely interested in science and was looking forward to experiencing more science in their lives. At this point, the end of seventh
grade, the class did not feel that science would become too difficult for them to study. One of the interesting findings of this research was that the class did not suggest that academic ability would determine one’s choices in science, even though students were already segregated by ability level of math class. The class talked about wanting to take a variety of science classes, none of which they ever described as difficult or only for smarter students. This finding suggests that sometime between middle school and high school students’ view of science changes (Barmby, Kind, & Jones, 2008; Braund & Driver, 2005; Pell & Jarvis, 2001, Speering & Rennie, 1996).

The class in this study, similar to those in studies by Jenkins and Nelson (2005), Osborne and Collins (2001), Braund and Driver (2005) and Logan and Skamp (2008) felt that learning science would be useful for future careers. The class in this study was interested in all areas of future science studies and expressed somewhat equal interest in learning chemistry, biology, physics, and space science. This finding is interesting in light of studies by both Bennett and Hogarth (2009) and Jenkins (2006), which found that students looked most forward to taking biology and least forward to taking physics.

Braund and Driver (2005) found that “students’ expectations for science on entering secondary school are high” (p. 88) and that they look forward to participating in science labs and other practical activities. Some students in this study suggested that they would enjoy classes involving chemical reactions, something in which students were currently involved outside of school. Due to this common interest, Archer et al. (2010) suggested that “one possible policy response might be to suggest that secondary school science be reformed in ways that would emphasize and play up its ‘dangerous’ potential” (p. 623).
Often the science in which the class was interested in learning in the future had a practical reason for it. They wanted to learn how chemicals explode or how animals lived. Many students expressed interest in learning more about the human body and health topics. The students have specific reasons for wanting to learn specific topics, but it is not likely that the students will have any input into the science content of their future courses.

It is interesting that many of the students are interested in learning about space science. Some students acknowledged that space was an interesting concept to them because there are still many things unknown. Collins and Osborne (2001) also suggested that students this age are interested in space because “such knowledge helps us to construct versions of self, identity, and our role within any cosmic order” (p. 457) and this knowledge comes at a time when students are starting to question themselves and their place in the universe. Space is a topic not typically covered by the traditional high school biology – chemistry – physics sequence, so one wonders what happens to the students’ interests if they are not addressed during the remainder of their schooling.

**Curare**

Students enjoy having their voices heard. Logan and Skamp (2008) suggested that students may feel more comfortable with school if the students feel like their teachers listen to what they have to say. The class in this study was eager to share its experiences with me and seemed to be forthcoming with its likes and dislikes. Whether the class felt comfortable sharing with me because I was an outsider is difficult to determine. Christensen (2004) suggested that to engage students in research requires a researcher to
connect to the students on the students’ level. Perhaps I was able to access the class because I was not their teacher and did not know them. It is impossible to know how the data collected would have been different if I had conducted this research with a class of my own students.

**Currere** is often a singular activity based on one’s personal situation and not necessarily shared with a group. The class seemed not to have engaged in a *currere*-type of activity before, specifically regarding science, as they had a somewhat difficult time recalling past experiences and future dreams as related to science. It was much easier for these students to participate in this discussion when they were part of a group. Although the conversations sometimes got off track and the students needed to be steered back to the topic of discussion, the answers and reflection of the students seemed much richer when the students were part of a focus group and not in a one-on-one conversation with me.

Dahl (1995) suggested listening to students’ voices is integral to understanding their experience in the classroom. The discussion of science *currere* in which I engaged with the class seemed to me to be valuable toward determining the understandings of these science students. Unlike quantitative studies, in which students are given options from which to choose answers, this study allowed the class the opportunity to answer open-ended questions, to discuss, and to be heard.

**Implications**

*A common theme in science education is concerned with how to improve the training of science students; however if one of the goals of science education is student persistence in STEM, it seems that teachers should focus on initiating*
interest and fostering engagement rather than on preparing for standardized examinations. (Maltese & Tai, 2010, p. 682)

There are several implications as a result of the findings of this study. Students in this study, who were at the end of their seventh grade year, still had very positive views of science in their future, which is similar to findings from Logan and Skamp (2008). The class in this study viewed science as a subject for everyone, not just for smart students. This study also showed little difference between genders in interest in science. These findings suggest that middle school might therefore be a time when teachers might encourage student engagement in science and might provide the academic resources to prepare students to be academically ready for future science classes.

Because the class had a wide variety of science interests, they should be provided with high school advising to help them take advantage of their interests. In addition, a wider range of science classes could be offered at high schools, at all academic ability levels, to capitalize on these students interests. Similar to findings by Jenkins and Nelson (2005), the finding of this current study suggest that the class already sees science as important in their future. Therefore, specialized course and career advice in school may be able to capitalize on this positive perspective.

The class seemed desperate for a connection between school science and the real world and also wanted to be engaged in the science they were learning. Students in secondary school may need assistance integrating school science and real world understandings (Lee & Songer, 2003; Reveles, Cordova, & Kelly, 2004; Songer & Linn, 1991). Students need to be helped to make these connections. Increased access to technology should provide easy opportunity for teacher to make these connections. It
seems that the advent and implementation of the internet in schools should make it much easier for teachers to be able to add relevance to science content. The class spent some time on the internet researching earthquakes during the earthquake unit, but earthquakes were not mentioned after the unit was completed, even though earthquakes continue to happen around the world. Students should be encouraged to share content connections they find outside of class with classmates during class time to increase the school-real world relationship. In addition, school science should be reframed in ways that approach “science”, with more inquiry-based activities, opportunities to collect real data, and student-led research.1

Teachers need to be aware of the importance of connecting prior knowledge to current content. This connection does not seem to be obvious to students and the repetition of topics works to turn students off of science rather than to increase their depth of knowledge. More teacher conversation across grade levels may help teachers to understand what and how science is taught over the K-12 continuum.

The class in this study reported fond memories of engaging in science activities as young children. The students’ family members also played an important role in introducing and encouraging science interests (Costa, 1995). Schools and community organizations might encourage science activities through family science nights, weekend science activities, or shared equipment and science kits. Schools might create mentorship programs using community individuals who are engaged in science to assist with school science learning.

1 “I borrow from Ida B. Wells the practice of using quotation marks around apparently self-evident terms in order to problematize them” (Pinar, 2001, p. 27). “Science” refers to the science in which scientists engage.
Science educators, schools, and communities should engage in innovative thinking as it relates to engaging students in science and in teaching science in schools. Science courses arranged by interest rather than grade level, older students partnering for science with younger students, and research opportunities for K-12 students at post-secondary institutions would provide opportunities that might take advantage of students’ active interest in science.

This study also suggests that middle school students have a great deal of experience with science in their lives. They have rich stories to share which should be part of the discussion about how to engage students in STEM-related areas. The students are eager to be heard and can provide much-needed insight into issues surrounding science education (Logan & Skamp, 2008).

Further Study

As suggested by this study students have much insight to offer those adults willing to listen to their stories. Therefore, further study related to methods of gathering class stories, experiences, and input would provide evidence of the trustworthiness of these approaches to gathering student data. Close attention should be paid to school discussions in which students are involved to determine how student voice is implemented and how outcomes are affected.

Research about student interest in science also needs to continue but should begin with students in primary school. Students become interested in science at young ages which suggests that longitudinal studies of students may provide more accurate information about what happens to student interest in science throughout the school
years. These types of studies should include opportunity for open-ended student talk and discussion.

New techniques and strategies to collect student voices is another area of suggested research. The variety of technology currently available allows for new options of gathering both group and individual voices, both in person and virtually. Technology also offers multiple options to engage students in discussions with each other, with teachers, and with others in the science community.

Variations on content tracking in science and mathematics, such as physics-first and eighth grade algebra need to be studied over time to determine the effect of these initiatives. All students should have the opportunity to take a variety of science classes in secondary school. Further research should focus on ways to make innovative sequencing possible.

As this study engaged a class from a specific demographic, future research should focus on engaging students from a variety of demographics in student voice work. Only through hearing students’ voices will researchers begin to understand students’ personal experiences with science.

**Conclusion**

Exploring the curriculum of a middle school class has given me insight into the rich science experiences of the students in this seventh-grade class. Although I previously taught science to seventh and eighth grade students, I did not realize the extent of science experiences that students this age bring with them to the classroom. Engaging in *currere* with this class allowed for me not only to understand more about the science
lives of the class but also to explore the process of currere with both myself and with the class.

I found immense value as an educator in engaging in the process of currere. The information I gathered about myself through this exercise allowed me to more closely understand my relationship with science and with the curriculum that I bring to the science classroom. It gave me the opportunity to explore my perspectives in light of the research that exists related to science education. Engaging in currere also freed me from predominant understandings in science education which allowed me to dream about other possibilities for science and what these might look like.

While I cannot speak for the class’ personal experiences with currere, I can discuss the benefit of the insight I received from hearing the class’ stories. Engaging with the class through currere substantiated my beliefs that multiple curricula exist in the science classroom. Considering the past, present, and future stories of the class allows for a unique glimpse of how the class positions itself in science at this moment. This understanding is valuable to me as an educator as it allows me to better integrate science content into the class’ life experiences.

Through this research I was reminded of the importance of student voice in discussions about education. Rather than a group of adults designing a prescriptive academic route that students’ must follow, it seems that students and the adults who work with them would be better served by engaging in conversations about content, curriculum, and pedagogy prior to major academic decisions. I believe that educational policy makers as well would benefit from truly hearing students whom their policies affect.


Kitzinger, J. (1994). The methodology of focus groups: The importance of interaction between research participants. Sociology of Health and Illness, 16(1), 103-121.


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APPENDICES
APPENDIX A
HUMAN SUBJECTS APPROVAL

NOTICE OF APPROVAL

Date: April 20, 2009
To: Kathleen Schwarte Crockis
173 Irwood Blvd.
Avon Lake, Ohio 44012

From: Sharon McWhorter, IRB Administrator

Re: IRB Number 2009-0405 “Toward a Rich Curriculum: Exploring the Curricula of Middle School Science Students”

Thank you for submitting an IRB application for Review of Research Involving Human Subjects for the referenced project. Your protocol represents minimal risk to subjects and has been approved under Expedited Category #7.

Approval Date: April 20, 2009
Expiration Date: April 20, 2010
Continuation Application Due: April 7, 2010

In addition, the following is/are approved:

☐ Waiver of documentation of consent
☐ Waiver or alteration of consent
☐ Research involving children
☐ Research involving prisoners

Please adhere to the following IRB policies:

• IRB approval is given for not more than 12 months. If your project will be active for longer than one year, it is your responsibility to submit a continuation application prior to the expiration date. We request submission two weeks prior to expiration to ensure sufficient time for review.
• A copy of the approved consent form must be submitted with any continuation application.
• If changes to the approved protocol occur, an amendment must be submitted to the IRB for review.
• Any adverse reactions/incidents must be reported immediately to the IRB.
• If this research is being conducted for a master’s thesis or doctoral dissertation, you must file a copy of this letter with the thesis or dissertation.
• When your project terminates you must submit a Final Report Form in order to close your IRB file.

Additional information and all IRB forms can be accessed on the IRB website at: http://www.uab.edu/resarch/compass/compass/IRBHome.php

Cc: Frances Broadway - Advisor
Cc: Stephanie Wark - IRB Chair

Office of Research Services and Sponsored Programs
4200 University Blvd., Suite 710, Box 20680
Birmingham, AL 35294-2068
Birmingham, AL 35294-2068

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NOTICE OF APPROVAL

May 3, 2010

Kathleen Schwartz Cross
173 Inwood Ave,
Avon Lake, OH 44012

From: Sharon McWhirter, IRB Administrator

Re: IRB Number: 2009-0405-2 “Exploring the Career of Middle School Science Students”

Thank you for submitting your Application for Continuing Review of Research Involving Human Subjects for the referenced project. Your protocol represents minimal risk to subjects and has been approved under Expedited Category #1.

Approval Date: May 3, 2010
Registration Dates: April 20, 2010
Continuation Application Due: April 6, 2011

In addition, the following blanket approvals:

☑ Waiver of documentation of consent
☑ Waiver of documentation of consent
☑ Research involving children
☑ Research involving prisoners

Please adhere to the following IRB policies:

☒ IRB approval is given for not more than 12 months. If your project will be active for longer than one year, it is your responsibility to submit a continuation application prior to the expiration date. We request submission two weeks prior to expiration to allow sufficient time for review.
☒ A copy of the approved consent form must be submitted with any continuation application.
☒ If you plan to make any changes to the approved protocol, you must submit a continuation application for change and it must be approved by the IRB before being implemented.
☒ Any adverse reactions must be reported immediately to the IRB.
☒ If this research is being conducted for a Master’s thesis or doctoral dissertation, you must file a copy of this letter with the thesis or dissertation.
☒ When your project terminates you must submit a Final Report Form in order to close your IRB file.

Additional information and all IRB forms can be accessed on the IRB website at:
http://www.uky.edu/research/corp/compliance/IRBForms.php

Cc: Francis Broadway - Advisor
Cc: Stephanie Woods - IRB Chair

☑ Approval consent form is enclosed

Office of Research Services and Sponsored Programs
Lexington, KY 40506-0022
859-384-1187 · 859-384-1188 · Fax
APPENDIX B

SEMI-STRUCTURED INTERVIEW PROTOCOL

1. What is your earliest memory of science?
2. Tell me about science you’ve done recently.
3. What science do you do outside of school?
4. What science would you like to do in school?
5. How does science impact your daily life?
6. What do you think science will be like in high school?
7. How does science affect your family?
8. How do you think science will affect your future?
APPENDIX C
DEMOGRAPHIC SURVEY

1. Did your parent(s)/guardian(s) graduate from college?
   □ No
   □ Yes, one of them
   □ Yes, both of them

Please check yes or no to the following questions:
In the past week have you...

<table>
<thead>
<tr>
<th>Activity</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read at least part of a book for school while at home.</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Discussed a current event with a parent or sibling.</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Watched a TV show with a parent.</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Watched a TV show about science.</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Read a newspaper or magazine article.</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Read (part of) a book for fun.</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Played computer games.</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Looked up information on the internet.</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

In the past year have you...

<table>
<thead>
<tr>
<th>Activity</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traveled somewhere outside of Ohio with family</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Attended a concert, play, or show (not school related)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Attended a professional sporting event.</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Been involved in a summer enrichment activity or camp</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Had lessons for a sport, instrument, or hobby (outside of school)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Visited a library (not at school)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Visited a zoo or museum</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Been on a college campus for any reason</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Played an organized sport</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
APPENDIX D

EXAMPLE OF PERSONAL NOTES

3/31/09
KSC Notes
At home after classroom observation

The class spent most of the time working on a project today. The project was making a Powerpoint about a specific earthquake that the students located on the USGS website. The students were told to pick to work either by themselves, with one other person, or two other people. A majority of the class is in pairs. The students had to find their earthquake and report it to the teacher so that each project would feature a different earthquake. Most students quickly picked an earthquake. They also needed to find an earthquake with a good amount of information about it in order to complete the ten slides.

Most groups found an earthquake pretty quickly. The students got to use computers. They each had a computer to use. They knew what to do and very quickly logged onto the computers and got onto the website and started working. Some groups choose to have one person look up information and the other person begin putting the information into the Powerpoint.

Mr. K. basically gave the students an outline of what information should go onto which slide, so the students were able to somewhat easily find the information they needed to put into the slides. The slides all started out quite colorful but the students
didn’t spend too much time on the ‘artistic’ nature of the slides. Most groups got at least the first two slides done.

The students pretty much seemed to ignore me. I was walking around and looking at the work they were doing and they didn’t say much or even look at me for the most part. They basically ignored that I was there. I did help one group to understand the word “amplitude”. They then sent one girl from their table to ask me what I was doing in their classroom. They know I was there to observe students but they didn’t know what I was doing. Alexa was the one who was sent over by her table. She then asked me where I went to school and where I went for my other degrees. She told me her dad went to State University as well.
APPENDIX E

EXAMPLE OF STUDENT INTERVIEW

Interview #3
4/24/09
KSC, Len, & David
Library at BMS

KSC: What is your earliest memory of science?

David: Earliest memory is probably...in either first grade or kindergarten...I'm pretty sure it was first grade. When I went to another school we had a science lab in that school and I remember doing a butterfly experiment with the monarch butterflies. We set up an environment and then let them go outside.

KSC: So you grew them? That's cool. How about you, Len?

Len: Me and my dad, um, before kindergarten....me and my dad took paper airplanes and tried to see how far we could throw it. Mine, of course, only went a foot.

KSC: What does your dad do?

Len: He's an aircraft inspector...at Continental

KSC: So anyway, tell me about science that you've done recently.

David: Growing Wisconsin fast plants...

KSC: OK.

Len: Um, earthquakes, and of course, volcanoes.

David: We studied tectonic plates.

KSC: Do you do any science outside of school?

David (smiling slightly): Yes, lots!
KSC: Like what?

David: Like I do experiments at my house.

KSC: Yea? Like what?

David: Chemical reactions, like baking soda and vinegar, and let's see, what else....

KSC: Did you do that just because.....why did you decide to do that?

David: First of all, because it's fun to like explode something. And just like to see if I could get, like what works with what, like.....more baking soda or more vinegar....

KSC: Did you do that recently?

David: Yea.

KSC: Did you see it in the book with the volcano stuff or you just did it?

David: No, I just did it. Yea, and I like, I don't know, just grow stuff for fun......

KSC: Like...fungus or...

David: Yea.

KSC: Oh, ok. I just wondered. (Turns to Len) what about you?

Len: Mostly anything that flies or explodes, I've probably played with it.

KSC: Do you think of it as science when you're doing it or do you think of it as just being fun?

Len: I just think of it as being fun.

David (cuts in): Well, sometimes, like some of the things I do, I don't think about science but a lot of things I actually chart, and like, graphlike plants and stuff.

KSC: Cool!

David (apologetically): I don't know why...

KSC: That's alright, it's interesting. Where do you find out about science?

David (without pause): On the internet, and in school I'll learn something and I'll try to recreate it at home.
Ok.

Len: Mostly either from books, class, or from my dad.

David (cuts in): And on, like, the Science Channel. I watch that.

Len (nods): Yea.

KSC: Like what shows?

David: Mythbusters, and ....

Len: Time Warp...

David: Yea, Time Warp's cool!

KSC: Does any of that stuff...do you find out that any of that stuff applies to school at all?

David: Yea, when we were learning about continental drift, I went home and watched the History Channel. And the whole program was about continental drift and everything we learned basically.

KSC: Oh, that's cool!(Turns toward Len): How about you? Does anything you watch on TV apply to school very much?

Len: Not really...

KSC: OK

Len: A couple times, um, something, like Discovery Channel when they're doing Mythbusters, seeing if somebody can survive a volcano.

KSC (laughs, referring to a class discussion): Now you know what it takes to survive a volcano, right?

David: Although I don't think goggles, long sleeves and pants will do it!

KSC: I had to look it up because I told Mr. K I would. I wanted to see, like, how far, if you had a volcano, like a big volcano, how far the ash would actually go.

David: I was watching this thing on the Science Channel about Yellowstone, and they were talking about how there's going to be a massive eruption...and that like in Europe....after about 3 months I think they said, it would be covered in two centimeters of ash.
KSC: Well, then you get those clouds and stuff....

Len: Yea....some volcanoes kick up enough ash to blot out the sun.

KSC: Yea...that would be interesting.....

Len (quietly): Krakatoa...we did a project on that.

KSC: Oh, was that yours?

David: Yea, it said that after it erupted it increased the earth's temperature like one degree Celsius for, like, a year later or something because that ash absorbed the heat.

Len: Because all the heat was getting trapped.

KSC: All right....do you think science is easy?

Len (chuckling): Yea.

David (chuckling): Yea. I kind of, like, some of the things on the Science Channel that I watch, like, they seem complex, or not, like, extremely complex...but I actually get them....but when I go back to school, it's not as, like, challenging.

KSC: What would you like to learn in science at school? What would you like to do in science at school?

David: Like, my favorite area of science?

KSC: Yea, or is there anything instead of doing the things you're doing?

David: I'd like to do either astronomy or like, particle physics. That's....I've just got interested in that.

Len (laughing): Pretty much aerodynamics or....pyrotechnics.

KSC (laughing): That would be nice, wouldn't it? Do you think the science you learn at school is useful?

David: Yea.

Len: Yea.

David: This year it's actually been pretty useful.

K: In what way?
David: I think it will be useful in the future, like, ah, the life science, like if we'd ever be working in any agricultural jobs or ..... 

Len (laughing): Also if you're caught in a volcano!

David: Earlier was life science, the first half of the year, so ..... 

KSC: So what did you do in life science? What did you learn in life science?

David: We learned cell structure...and, um, the roles of the organelles.

KSC: OK, did you do heredity?

David: Yea

KSC: And genetics?

David & Len: Yea

KSC: And you did fast plant this spring?

Len: Yea

KSC: Um....let's see.......is science important?

David & Len: Yea.

KSC: Why? Why do you think science is important?

Len: Probably because everything you do is technically science...and if you're working somewhere like, ....I don't know.....let's just use...the airport, you're probably figuring out and graphing which pretty much includes all math, which is science,...um, how well the flights went, if they took off on time, I don't know...

KSC (to David): What do you think?

David: I think science is basically almost everything around us, and if you're good at science, if you're educated well in science you'll be good at many more occupations.

KSC: Do you think it's important for, like, younger kids to learn science?

David: Yea, definitely because I think if kids are, uh, learn to get interested in science when they're young, I think like every kid would grow up to be a scientist.

KSC: So....why doesn't every kid grow up to be a scientist?
David: I think teachers make it seem, uh.....

Len: ...more complex than it really is.

David: Well, yea, and, I don't know, I don't think they really enforce that it's like "fun" or encourage that it's fun.

KSC: So what makes it fun?

David: Fun is like seeing results of the experiments or...

Len: working with your hands...

David: yea, and um, looking at the progress of an experiment over time.

KSC: So...like how would you do something like that with the volcanoes that you're doing now?

David: Um......say you like build a replica of a volcano, and then when you're all done, you activate it or however you want to do that, and see it erupt. That would be cool.

KSC: Umhmm.

David: because you then know how it would look on a larger scale.

KSC (to Len): Ok, what do you think?

Len (pause): I don't know.

KSC: Do you think little kids, I mean do you think kids should learn science?

Len: Yea

KSC: I mean do you think it affects their daily life?

Len: Probably, yea.

KSC: How?

Len: Crap, um.......hard to explain, um......

KSC: How do you think science is going to affect your future?
David: I think ...the progress of technology, I think ....we're gonna need to be a lot more involved in science because we're gonna need to know how to use the technology and we're going to need people to develop the technology.

K: OK

Len: Um.....We're....I'm definitely going to be in a job that includes science with robots or something like that, ....and like David said, with the technology increasing and needing to know how the technology works to be able to run......, pretty much, your job.....

KSC: What kind of technology do you think is going to be developed.....like in the future? Like....what do you see happening as you get older?

David: Um....well......more like genetic, uh, engineering basically,

KSC: OK

David: Like, because we're going to need more food in the future. I know that the population is growing and, uh, I think computer technology, because I heard on a show that I think it doubles every two years or something....

KSC: Something incredible like that....

David: Yea, if it keeps doubling, that's pretty......

KSC: Do we need it to keep doubling?

Len: Probably not.

David: I think, we, I think probably because...I take that back, we don't need it to keep doubling.

KSC: No, you can answer yes or no, I'm just wondering what you think.

David: Because, I mean, we've survived without it before......

Len: Probably the ordinary flying cars idea and um, smarter technology that works faster and does a lot more.

KSC: OK, for what.....give me an example.

Len: Let's just say a robot that vacuums your house, cleans your house and cooks meals.....I don't know.
KSC: That would be cool. I would like that! Um, so do you plan to go onto science? Are you interested in like studying science?

David: Yea.

Len: Definitely!

KSC: So what would you say right now, if you had to say you were going to go to college, what would you picture yourself doing?

David: I would picture myself either going into aerospace engineering or probably, like I said, probably like a particle physicist.

KSC: Can you explain particle physics to me?

David: Well it's basically those blocks of matter, I guess you could call it, what makes up atoms and how atoms are formed, I mean work, basically. I guess you could say how they're structured.

Len: I'd pretty much go into aeronautics, aerodynamics...that's pretty much all I want to do.

KSC: What science do you plan to take in high school? Have you thought about that at all?

David: Physics, chemistry....

Len: Definitely chemistry.

KSC: Why definitely chemistry?

David: Because it's kind of fun seeing what happens, like Len said, with chemical reactions.

KSC: OK, I think I'm done for right now. Thanks, guys.

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