Abstract

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Education researchers and practitioners are increasingly recognizing the need for learning in informal settings to complement formal science learning (Bybee, 2001; Falk, 2001). Informal science education may be critical in meeting the goals of reform and in keeping students and the public informed of advances in science. As such, greater attention has been given to learning in informal science settings. A growing body of research examines how groups engage in learning conversations to make meaning from content and exhibits in these settings. The National Research Council (2009) speculated that individual and group identity might be shaped and reinforced during such learning conversations.

The central research question guiding the study was: What is the role of conversation in influencing science learner identity development during an informal science education camp? Identity in this study was defined as becoming and being recognized as a certain type of person (Gee, 2001). This study focused particularly on discursive identity, defined as individual traits recognized through discourse with other individuals (Gee, 2005; 2011).

The study used an exploratory case study. Data collection included videotaped observations, researcher field notes, interviews and participants' reflective journal

entries. Each source of data was examined for the conversation that it generated. I used qualitative methods to analyze the data including discourse analysis and the constant comparison method for emergent themes.

From the findings of this study, I theorized that the learning conversations played a role in developing participants' identities as learners of science. Participants used language in the following ways: to make sense of science content, to position themselves, to align their discourse and practices with science, to communicate with others which resulted in engagement, to re-negotiate power, and to see others in new ways.

The findings of this research support and extend the research literature on identity, learning conversations in informal science education environments and science camp programs. Implications from this study include recommendations for the design of science camps to support identity development as learners of science for participants.

IDENTITY DEVELOPMENT OF MIDDLE SCHOOL STUDENTS AS LEARNERS OF SCIENCE AT AN INFORMAL SCIENCE EDUCATION CAMP

By

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DEDICATION

This dissertation is dedicated to my Aunt Karen.

Her courage and positivity were an inspiration.

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Introduction

Learning is as much about becoming as it is about knowing (Nasir, 2002). Identifying as a learner influences what activities we participate in, our motivations and interests toward learning, and how we see ourselves fitting within different communities. Anderson (2007) argued that one aspect of learning is enculturation. In this view, learning is about acquiring the skills, concepts, and practices of a community, what Anderson refers to as identity. Enculturation and identifying as a learner, he argued, occurs through social participation. Informal learning environments provide numerous opportunities for social participation (Dierking, Falk, Rennie, Anderson, and Ellenbogen, 2003; Falk & Dierking, 2000; Falk & Storksdieck, 2005; National Research Council, 2009). Many of these contexts prompt social interaction as participants attempt to make meaning from content. Investigations in these contexts have looked at how groups engage in learning conversations to make such meaning. The National Research Council (2009) speculated that during these learning conversations, group and individual identity is constructed. This study examined a science camp program to gain an understanding of how individual and group identity develops during learning conversations of middle school participants. In this study, I define conversations as the social interactions between group members and distinguish it from dialogue which I viewed as an exchange between two individuals.

This study is guided by the following central research question: What is the role of conversation in influencing middle school science learner identity development during an informal science education camp? To explain the reasoning for this study, this chapter begins with background information, a statement of the problem, discussion of the significance of the study, the epistemological orientation of the study, the positionality of the researcher, assumptions and limitations of the investigation.

Identity Development. Gee (2001) defined identity as becoming and being recognized as a certain type of person. Identity is socially constructed and can be influenced by the practices of a given community. Identity is an important aspect of learning. Brickhouse, Lowery, and Schultz (2000) argued that a fundamental question to ask related to learning is whether students see themselves as the type of person that would want to learn science. They suggested that how a learner engages with science is influenced by their identities.

Sfard and Prusak (2005) argued that there is only one form of identity that is “reifying, endorsable, and significant” (p. 17). This identity is the story that the learner addresses to themselves, the first-person, self-told identity. Sfard and Prusak go on to describe second and third-person identities. Second-person identities are the narratives that the identified tells to others whereas third-person identities are those told by a third-party to others. First-person identities are the identities which are most influential in guiding an individual’s actions.

Some researchers view that identity is socially situated and constructed during discourse (Anderson, 2007; Gee, 2001). Gee (2001) identified one view of identity as a “Discourse-Identity” (p. 101). A “D-Identity” was defined as a trait recognized through discourse with others (p. 104). Gee (2005) argued that as social beings, we use language to enact an identity and get recognized as a certain type of person. Through discourse, aspects of identity are constructed and/or sustained. Likewise, Brown (2006) indicated that through discourse, individuals signal meaning in an attempt to help others identify them as a particular kind of person. Identity is socially constructed in the moment-to-moment interactions between learners.

Identity, in this view, is dynamic and malleable. Anderson (2007) describes identity as an ongoing construction of who we are which develops through participation with others in the experience of life. Given the socially constructed nature of identity, there is reason to believe that identity development might take place in informal learning environments. These environments provide multiple opportunities for social interaction and joint construction of meaning as participants in these settings attempt to make meaning of content (Falk, 2009). The conversations that participants engage in during social interactions in informal learning environments are referred to as learning conversations (Allen, 2002; Crowley, Callanan, Jipson, Galco, Topping & Shrager, 2001). Through the discourse that surfaces as a result of these meaning making conversations, participants may have opportunities to engage in identity development (National Research Council, 2009).

Importance of Identity for Learning. Nasir (2002) argued that learning is about becoming as well as knowing and that how the learning setting affords ways of becoming is central to understanding learning. Varelas et al. (2007) stated that seeing oneself as a capable learner is an important component of one's identity as a learner of science. An identity as a capable learner can influence the practices an individual engages in as well as the trajectories available to the learners within these practice (Nasir, 2002). Nasir stated that when students are encouraged to build strong identities as learners, learning and achievement are enhanced.

The National Research Council (2009) highlighted the influence of identity on affective dimensions such as motivation and interest. They commented that identifying as a learner of science is linked with positive affective and motivational issues that can provide an individual with access to scientific communities and careers. That is, if an individual identifies as a learner of science, he/she may have the motivation and interest to engage in the practices of the scientific community as well as pursue a career in this field.

Brickhouse et al. (2000) hold a similar belief and suggested that how students engage in school science is influenced by their identities. Students' views of themselves as the kind of person who engages or does not engage in science will impact their participation and learning of science. If we hope to engage students meaningfully in the practices of the science community, it is essential that they come to view themselves as learners of science. Brickhouse et al. commented that traditionally researchers have concerned themselves with determining whether or not students were learning an accurate and scientific view of the world. They argued that a more important, fundamental question is whether students want to engage in science. They offered the following insight: "we have not sufficiently attended to the more fundamental question of whether students see themselves as the kind of people who would want to understand the world scientifically" (p. 443).

Informal Science Education. Learning science is not confined to schools. Bransford, Brown and Cocking (1999) estimated that students spend, on average, less than 14% of their time in schools. Rennie (2007) reiterated this notion, stating that "most people spend less of their lives in school than out of it, and they continue to learn throughout their lifetime in many places other than educational institutions" (p. 125). The public learns science in a variety of contexts and from a number of sources, including learning science in informal learning environments (Dierking et al., 2003; Falk, 2001; Falk & Dierking, 2000).

Rennie (2007) characterized informal science education as opportunities to learn science outside the formal classroom context. These experiences include, but are not limited to, museums, science centers, zoos, aquaria, botanical gardens, nature centers, afterschool programs, science camps, the internet, television, and film (Anderson, Druger, James, Katz, & Ernisse, 2001; Dierking et al., 2003). These types of experiences often have several characteristics in common. Crane (1994) indicated the following features are common to informal science education: “activities that occur outside the school setting, are not developed primarily for school use, are not developed to be part of an ongoing school curriculum, and are characterized by voluntary as opposed to mandatory participation as part of a credited school experience” (p. 3). Hofstein and Rosenfeld (1996) also suggested that informal science education experiences are often non-assessed and non-competitive. Dierking et al. (2003) added that informal science education is characterized as being driven by the needs and interests of the learner.

Informal learning experiences offer opportunities for social interactions. During informal learning experiences, participants engage in learning conversations with one another (Crowley, Callanan, Jipson et al., 2001; Zimmerman, Reeve, and Bell, 2009). Ash (2003) and Zimmerman et al. (2009) posited that groups engage in meaning making through learning conversations in informal learning environments. Through these social interactions, the group attempts to make sense of the content presented in the exhibit or program.

Positive Outcomes of Informal Science Education. A review of the literature on informal science education suggests a number of positive outcomes. One positive aspect of informal science education is that it may complement science learning in the formal classroom. The need for learning in informal settings to complement formal science learning is being recognized in science standards documents. For example, the *National Science Education Standards* indicate that the classroom is a limited environment and that school science must utilize the resources within the community. The *National Science Education Standards* explicitly called for learning that extends beyond the classroom to address reform initiatives (National Research Council, 1996). Similarly, Osborne and Dillon (2008) indicated that students spend only a small proportion of their time in school and it is as important to understand what happens outside of school as it is to understand what happens in school. The *American Association for the Advancement of Science* (1989) recognized that students learn in museums, zoos, and other out of school contexts and as such called for learning opportunities that “extend beyond the school” (p. 206). Bybee (2001) and Falk (2001) argued that informal science settings can support and complement formal science, particularly in meeting the goals outlined in science reforms.

One way that informal learning environments might support formal learning is by fostering positive attitudes and interests toward science among students. Szechter and Carey (2009) suggested that informal learning experiences can spark children’s interest in understanding science. They indicated that a focus on interest was a means by which informal learning environments might support formal science in the classroom.

Informal science experiences may be more inclusive settings for groups traditionally under-represented in the science field. In particular, the voluntary aspect may spark students’ motivation and interest as they have a choice of the informal programs and science content with which they will engage. Anderson et al. (2001) pointed out that informal science education serves diverse learners by accommodating their differing interests and offering unique opportunities through experiential learning. Hofstein and Rosenfeld (1996) identified informal learning as being non-assessed and socially constructed, additional features which may encourage all learners to engage in science. These experiences may influence students' attitudes related to science and could encourage students from under-represented groups to continue engaging in science and potentially choose science as a career.

Crane (1994) articulated additional outcomes of informal science learning. Informal science learning may be a means to reach the public after they leave the formal school system. Through experiences in informal settings, the public can remain informed of current issues and advances in science. A scientifically informed public is essential for making educated decisions in terms of science-based issues in everyday life such as public policy, health, and environmental awareness.

There have also been outcomes cited in the literature when informal science education is used for formal science teacher preparation. A review of the literature on the integration of informal science education in formal science teacher preparation suggests a number of benefits including: affective learning outcomes (Chesebrough, 1994; Riedinger, Marbach-Ad, McGinnis, Hestness, & Pease, 2011); exposure to reform-based pedagogy (Anderson, Lawson, & Mayer-Smith, 2006); and access to resources (Chin, 2004; David & Matthews, 1995). Several authors have posited that the unique aspects of informal science education might positively influence teacher candidates' identity as a classroom teacher of science. In the study reported by Katz et al. (2010), teacher candidates participated in an afterschool informal science education internship during their teacher preparation program. Katz et al. found that the afterschool internship positively influenced teacher candidates' identities as classroom teachers of science. Riedinger et al. (2011) investigated the infusion of informal science education in an elementary science methods course and found that the innovation had a particular influence on teacher candidates' attitudes and beliefs toward the field of science, science teaching, and science learning. Given the research on the influence of informal science education on teacher candidates' identities as classroom teachers of science, there is reason to speculate that informal science education might also influence middle school students' identities as learners of science.

Although a number of positive outcomes of informal science education have been identified in the literature, the causes of these outcomes are unclear. This study sought to contribute to the literature in this area. In this study, I elucidate the role of conversations in promoting students' identity development as learners of science.

Science Camps. Nicholson, Weiss, and Campbell (1994) and Rennie (2007) identified community-based programs as one category of informal science education. Community-based programs include such experiences as afterschool programs, discovery programs, science camps, and career apprenticeships (Nicholson et al., 1994; Rennie, 2007). Nicholson et al. (1994) and Rennie (2007) characterized science camps as short-term programs that are intensive with regard to involvement in science activities. Science camps are often residential or day camps (Fields, 2007) and usually focus on promoting confidence and competence to pursue science (Rennie, 2007). Fields (2007) indicated that science camps are typically offered during summer and winter breaks from school. The camps focus either on science generally, or on specific sub-disciplines such as marine science, astronomy, environmental science, physics, or nanotechnology. Another distinguishing feature of science camps is they are often homogenous with regard to participants' age, grade, and socioeconomic status (Fields, 2007).

Fields (2007) and Johnsen (1954) both described that science camps address affective aspects of learning and attempt to increase motivation and confidence among participants. This goal is accomplished in numerous ways. Science camps are commonly held in novel, exotic locations such as the marine environment, mountains, wilderness, and university campuses. These novel locations may spark interest for students and provide a memorable experience. Learners often participate in authentic science projects and learning activities that foster curiosity and exploration (Fields, 2007; Johnsen, 1954). Science camps focus on apprenticeship models, hands-on activities, and inquiry methods which researchers theorize may be more motivating for students (Barab & Hay, 2001; Gibson & Chase, 2002; Markowitz, 2004; Sondergeld, Rop & Milner, 2008). Science camps can provide participants with access to resources not typically available in the formal school setting. Laboratory equipment, research methods, and professional scientists are examples of novel resources provided by science camps that may influence affective dimensions of learning (Barab and Hay, 2001; Markowitz, 2004; Robbins & Schoenfisch, 2005).

Rath and Brown (1996) provided a description of a science camp program that supports the contention that science camps influence affective outcomes of learning. In a series of vignettes, they described,

> In one classroom a normally very active second-grade boy lies on the ground next to the class ‘pond’ (constructed in a children’s swimming pool) and calmly holds a salamander for several minutes. In another classroom a third-grade girl modifies and explores her tornado tube over a period of 2 hours, never seeming to lose interest in the water flowing between the connected 2-liter bottles. In yet another classroom two fifth-grade girls work with energy and enthusiasm on their machine constructed for the purposes of making

strawberry milkshakes from imaginary strawberries and ice cream (water) flowing through actual plastic tubes. (p. 1083)

The vignettes presented by Rath and Brown illustrate several instances in which science camp activities fostered interest and excitement about science learning among students.

Other studies on science camps report similar results. For instance, Stevens, Shin, Degado, Cahill, Yunker and Krajick (2007) administered a previously developed survey to assess the influence of a science camp program on students' attitudes. An examination of students' pre- and post-camp responses suggested that over 90% of the science camp participants in the study maintained a positive attitude toward science as a result of the program.

Gibson and Chase (2002) concluded that a science camp program can have long-term gains for students as well. In a longitudinal study of program impacts, Gibson and Chase contacted participants that had previously participated in a science camp program. Participants responded to two quantitative surveys: the Science Opinion Survey and the Career Decision-Making survey. Pretest and posttest scores indicated that after two years, science camp participants maintained a more positive attitude toward science and higher interest in science careers than non-science camp participants.

Likewise, Markowitz (2004) examined long-term gains of a different science camp program. Markowitz administered a follow-up survey to participants that had previously completed the science camp program one to seven years ago. Markowitz concluded that the science camp program positively influenced participants' perceived abilities in science, participation in extracurricular science activities, and interest in pursuing a science career.

Because science camps are believed to facilitate changes in affective dimensions of learning, students are often recruited to these programs during middle and high school when identity is formative and students, particularly those from groups traditionally underrepresented in science, are more likely to disengage from the discipline (Markowitz, 2004; Schriver, Wolfe, & Strickland, 1995). This is also roughly the time when students are believed to begin seriously considering career choices (Johnsen, 1954; Moore, 2003). In an evaluative report on informal science programs, the National Science Foundation (1998) concluded that many adults in science careers attributed their initial interest in science to an experience in an informal setting. A positive experience at a science camp may foster affective dimensions of learning and may impact aspects of students' identities as learners of science.

Given the potentially positive influence that a science camp program can exert on students' identities as learners of science, it is an important topic for investigation. The purpose of this study was to investigate the ways in which such a program influenced middle school students' identities as learners of science.

Middle School Students. Middle school typically includes either grades five through eight or grades six through eight (Alexander, 1968; Klingele & Siebers, 1980; Turnbaugh, 1968). This grade organization grew out of the middle school movement. During the 19th century, schools were organized into a pattern in which the first eight years of schooling constituted elementary school and the final four years of schooling constituted high school (Manning, 2000). At the turn of the century, many school shifted to a junior high school model which served as a transition period between the elementary and middle school. This model usually separated grades seven and eight in a separate school known as the junior high school. The purpose of the junior high school was to provide adolescents with specialized instruction that fit their unique developmental needs (Manning, 2000). Around the 1950s and 60s, questions surfaced as to whether junior high schools were truly meeting the needs of adolescents or simply mirroring the high school. This prompted the middle school movement.

Educators posited a number of advantages to the middle school model. Alexander (1969) indicated that students during this period are in a transition between childhood and adolescence. According to Atkins (1968), students must deal with changes in their bodies, attitudes, interests, and relationships as they make this transition. The middle school model was intended to meet the unique developmental and educational needs of early adolescents (Manning, 2000). Other advantages were also identified. Alexander (1969) suggested the middle school was a better bridge from elementary to high school. He argued that the junior high model was too similar to high school and did not meet the unique challenges of early adolescent students. Turnbaugh (1968) added that with the previous junior high model of only two grades, student turnover was rapid and it was difficult to develop a cohesive student body. The three year middle school model might provide a smoother transition to adolescence.

The middle school movement was distinct from the junior high school movement in a number of ways. Middle schools were intended to be learner-centered and to incorporate innovative practices and programs (Atkins, 1968). Middle schools added team teaching strategies in which student cohorts were established. Each cohort of students was taught by the same team of teachers. This strategy departed from the old junior high school model in which students each had a different set of teachers for the different subject areas. Many middle school also adopted block scheduling as opposed to the traditional schedule of equal periods (Alexander, 1968).

I believed an examination of identity development as a learner of science during middle school would be a fruitful area of research. Atkins (1968) suggested that this time is a formative period for students. Young adolescents have many competing interests and motivations during this stage as they attempt to define who they are (Erb, 2007). This is also a period when interest in learning can be diminished. With specific regard to science learning, Koballa and Glynn (2007) reported that elementary school students typically have positive feelings and attitudes toward science. However, these feelings and attitudes often decline during the middle and high school years. Johnsen (1954) and Moore (2003) also suggested that this is a period when students begin seriously weighing career options. These factors warranted an investigation of identity as a science learner during students' middle school years.

Statement of the Problem

A current line of research in informal education has investigated the ways in which groups engage in learning conversations to make meaning of content in informal learning environments. Such research draws on sociocultural theories of learning and focuses on the group as a unit of analysis (National Research Council, 2009). Much of this research has looked exclusively at family groups in the context of museum-like settings (e.g., natural history museums, science centers, aquaria, zoos). In this section I highlight the problem that this research study sought to address.

Studies of informal learning environments have focused on museums and science centers as a context. Other contexts have been understudied or ignored (Schauble, Beane, Coates, Martin, & Sterling, 1996). Fields (2007) commented that there is a dearth of studies in science camp settings. The scant literature that does exist is limited to anecdotal accounts of how to start a science camp program. Rennie

(2007) speculated that museums often receive the most attention because researchers consider studies in this context as applicable to other informal learning settings. However, I believe that research insights from museum settings are not necessarily directly applicable to other context such as science camps. Dierking et al. (2003) suggested that although data from museum studies can serve as a baseline for understanding learning in other informal science education contexts, comparable studies in venues such as science camps are still needed. Science camps have specific features that distinguish these programs from other forms of informal science education. Earlier, as Nicholson et al. (1994) pointed out, science camps are distinct from other informal learning environments in that they are intensive programs that are often residential, offered in exotic locations, and homogenous with respect to participants' demographic information.

Falk and Dierking (2000) and Falk and Storksdieck (2005) suggested a contextual model of learning to characterize learning in informal learning environments. According to their theory, learning in informal environments is influenced by the personal context, the physical context, and the sociocultural context.

With regard to the physical context, science camps are often situated in authentic contexts. The artifacts and tools that make up the physical environment are also unique depending on the context. Science camps often provide students with authentic science equipment and tools. These aspects of the physical environment may prompt identity development as a learner of science.

The sociocultural context suggests that learning is influenced by the interactions and collaborations a learner has with their social group, teachers and informal science educators. Rennie, Feher, Dierking, and Falk (2003) indicated that the family group is often the social group in museum settings. However, in the science camp setting, the group is typically composed primarily of peers. Social interactions between peers may foster equitable relationships between group members and could encourage identity development as a learner of science.

Given that elements of the sociocultural and physical context vary between museum and science camp settings, there is reason to believe learning in each context is unique. Thus, systematic investigations of how students learn and develop identities as learners of science in a science camp context are still needed.

A majority of previous research on learning conversations has examined how parent-child and adult-child groups interact in informal learning environments (Astor-Jack, Whaley, Dierking, Perry & Garibay, 2007, Crowley, Callanan, Jipson et al., 2001; Crowely, Callanan, Tenenbaum & Allen, 2001; Zimmerman et al., 2009). Astor-Jack et al. (2007) called for related research to investigate how peers engage in conversations. They indicated that peer conversations have not been well documented in the literature. As such, it is unclear what constitutes optimal social interaction between peers, what conditions foster interaction between peers, and what nonverbal methods peers use to communicate with one another during conversations.

There is reason to believe that conversation between peers may look different than those between an adult and child. Falk and Dierking (2000) speculated that talk between peers might be more focused than adult-child conversations. They believed that when students engaged in talk together, they would focus on topics that were of interest to them rather than those topics deemed important by the teacher. Therefore, the nature of the conversation may be different when an adult is not directing the talk and students are free to explore, on their own, various topics and modes of interaction.

Rogoff (1998) posited that collaboration between peers leads to more equitable participation and diminished power relations in learning contexts. She speculated that an adult child conversation creates a power dynamic in which the adult may dictate the direction of talk. Learning conversations between peers may be more equitable and may provide opportunities for students to consider new identities as a science learner. These differences suggest that learning conversations between peers may be inherently distinct from those between adults and children. These differences also link back to Falk and Dierking (2000) and Falk and Storksdieck's (2005) notion of the sociocultural context. The sociocultural context will be different depending on the composition of the social group (e.g., adult-child or peer-peer group) and will influence learning in informal science environments. Thus, it was important to investigate how peers socially interact in a science camp program.

Several researchers have explored various aspects of identity in the context of informal learning environments. In an investigation of a science camp program, Wheaton and Ash (2008) found that participants' self-identities influenced their science camp experience and resulting views of science. However, they failed to clearly articulate their view of identity and seemed to take a broad view of identity as any view of oneself.

Stainton (2002) examined how art museum visitors' identities influenced meaning-making processes during the visit experience. She viewed identity as any prior knowledge or experiences in a person's history that influenced their interpretation of art exhibits. Stainton concluded that visitors' identity dictated the type of talk; half of the talk during conversations was visitor prompted based on their prior knowledge and experience rather than prompted by the museum.

Similarly, Falk (2009) described that visitors' identity dictated the visit experience in terms of what exhibits the visitor attended to and what meaning they made of the content presented. Due to the free-choice nature of informal learning environments, visitors will choose to engage with exhibits that meet their identity-driven needs. Falk and Dierking (2000) provide a vignette that I believe highlights this notion. They described Benjamin's experiences at the Smithsonian's Natural History Museum. Benjamin was interested in dinosaurs; he owned several books about dinosaurs and periodically watched videos about them. Benjamin and his family had previously visited the museum and discussed their experiences at home. These aspects of Benjamin's identity seemed to influence his visit to the museum. He showed a preference for, and visited, the exhibits for which he had interest and prior experience. In terms of science understandings, he related new information to his prior knowledge. For example, after exploring a *Triceratops* skeleton at an exhibit, Benjamin commented that the bones were thicker than he originally thought. Benjamin's identity, as conceptualized by Falk (2009), guided his visit experience and the meaning he made from the exhibits.

Stainton (2002) and Falk (2009) both viewed one aspect of a visitor's identity as the prior knowledge and experiences that visitors bring with them to the museum experience. Both considered that visitors' identities influence the visit experience and the meaning that visitors make of the experience. Their views seem to consider identity as static throughout the experience. That is, visitors' identities are the same before and after the visit experience.

Conversely, the National Research Council (2009) speculated that individual and group identity might be shaped and reinforced during learning conversations. If a view of identity as situational is adopted, the novelty of an informal learning environment would prompt changes to an individual's identity. Although studies in informal learning environments have examined the influence of identity on the experience, these studies have failed to look at how identities might be constructed during the experience. This study took a more dynamic view of identity and examined the ways in which identity as a learner of science was constructed or sustained during learning conversations at the science camp.

The studies reviewed provide insight related to the research question, but are still limited in several regards. First, research in this area has examined conversations in the museum context, but applications to other informal learning environments are still lacking. Second, previous research addressed learning between family groups, or adult-child interactions. Peer interactions have been less well-documented (Astor-Jack et al., 2007). Third, examinations of how conversations in informal learning environments foster identity development as a learner of science are lacking.

The gaps in the literature suggest a need for research examining peer conversations and the construction of identities as learners of science in the specific context of a science camp program. This study was designed to address this gap in the literature by examining the role of conversation in influencing science learner identity development during a science camp. In the next section, I articulate the significance of this study.

Significance

Research on learning conversations in informal science education settings is important to learn effective strategies for facilitating such talk among groups participating in these settings. Astor-Jack et al. (2007) argued that it is unclear what factors are necessary to optimize social interactions at museum exhibits and other informal programs. They suggested that research in this area might help educators create effective strategies for promoting adult-child and peer-peer interactions among visitors. For instance, Szechter and Carey (2009) indicated that some exhibits promote what they refer to as active prolonged engagement. Aspects of these exhibits promoted and facilitated group talk and engagement with exhibits. At these exhibits, children were more likely to describe evidence and parents were more likely to elicit predictions from children.

Studies that elucidate factors associated with conversation might guide exhibit and program developers. The National Research Council (2009) indicated that results from research on family learning are transforming the missions, educational strategies, and experience in museum settings. Related research on learning conversations in science camps might guide program development. As we gain an understanding of the nature of learning conversations in these settings, program developers can incorporate these factors into program design to faciliate conversations between peers in science camps.

Positionality

My positionality as a former educator in both informal and formal settings will influence how I collect and interpret data. As a former educator in both settings, I consider myself aware of the unique characteristics that define each setting. I have particular notions of the norms and rules that operate in each setting. Specifically, through my experiences as a classroom teacher, I observed students disengage from science as they became uninterested and unmotivated in the subject. The testing pressures and accountability measures in the school environment created a classroom community that was not conducive to collaboration and I believe created a power dynamic. Teachers, in an attempt to adapt to the testing regime, shifted to more didactic methods of instruction to cover all of the content laid out in the state and local curricula. These didactic teaching strategies, in my opinion, resulted in the presentation of science as a canon of facts, disconnected from the lives of students. I believe that students came to see science as not important to their lives and did not view themselves as learners of science.

On the other hand, as an educator at an aquarium, I was able to observe students engaged with science in a way that I believed for them was meaningful and exciting. The learners were able to engage with activities that they viewed as personally interesting and relevant. In the aquarium setting, the content was presented through real-life situations which I believed was more meaningful for learners. Participants in this setting seemed to be motivated to learn science and identified as learners of science. Through these experiences as an educator in multiple settings, I came to view that some setting are more conducive for identifying as a learner of science than others.

My experiences as a learner in informal science settings have also molded how I think about science learning. I come from a family that would not necessarily identify themselves as learners of science. However, I view that members of my family actually engage in science learning quite frequently. Through informal activities such as watching the discovery channel, cooking, building a house, or problem solving to repair an air conditioner, my family members gained an understanding of science which they used in their everyday lives. For example, I began scuba diving with my father when I was 13. During our excursions, we would participate in activities such as collecting shells, identifying marine organisms, or experiencing the power of a current. We would later engage in discussions in which we attempted to identify the organisms and make sense of information related to these organisms. Although such activities might not fall under traditional notions of science content, I view these activities as constituting science learning.

I believe my experiences as a learner in informal science education molded my identity as a learner of science and influenced my participation within the field of science. The informal science education experiences I had with my family fostered my interest in science and helped me to identify as a science learner. As I continued in science, my identity helped me to persist in this field, despite challenges. For example, my position as a female trying to enter the field of science was often contested. During animal dissections during middle school, I had a teacher tell the class that girls are usually "grossed out" by these activities and choose to pair with a male student to complete the activity. In graduate school, a professor announced to me that most girls perform poorly in his class. As a lab assistant, I was assigned to cleaning glassware while my male peers participated in every aspect of the research activities of the laboratory. I believe that my strong identity as a learner of science enabled me to persist in science despite these discouraging events. My reflections on my own identity development as a learner of science as well as my experiences in the field of science have shaped my conceptualization of identity for the present study. I have come to see how identifying as a learner of science can influence one's learning and participation within a community of science.

The study was also influenced by my experiences as a doctoral student. Project Nexus was an National Science Foundation funded project to develop and test a science teacher professional development model that prepared, supported, and sustained elementary and middle specialist science teachers. The aspects of the Project Nexus model included a reform-oriented science content course, an afterschool informal science education internship and a reform-oriented elementary science methods course.

As a graduate research assistant with Project Nexus, I have examined connections between formal and informal science education. The second year of our project investigated the influence of an afterschool informal science education internship on teacher candidates' developing identities as classroom teachers of science. In year three, we developed an innovative elementary science methods course that included aspects of informal science education. I assisted in implementing these aspects of informal science education in the elementary science methods course and taught a section of the course as an instructor during the fall 2008. Through this project, I have come to view the ways in which informal science education can complement formal education.

My work with Project Nexus has influenced how I view identity. We have used classroom science teacher identity as a theoretical lens for interpreting our study (Katz et al., 2011; Katz et al., 2010). Our study examined how experiences with informal science education, such as an afterschool informal science education internship and connections with informal in a science methods course, shaped teacher candidates' identities as elementary teachers of science. We viewed that identifying as an elementary classroom teacher of science would prompt teachers to align their teaching practices with science reform recommendations. We further viewed that a strong identity as an elementary teacher of science would help Project Nexus teachers persist despite any local constraints of their school context such as testing pressures. Our use of identity for this study has further influenced my view of this theoretical construct.

The various perspectives that I approach this study with have shaped how I think about science teaching and learning. Much like Barton (2003), I challenge what should be counted as science knowledge and suggest that individuals engage in science learning in their everyday lives at home, at school, and in their communities. I believe that there are learning experiences beyond classroom science that impact individual's identities as learners of science. Experiences in contexts outside the science classroom can positively influence identity. My position as a former classroom teacher, a former informal science educator, and informal science learner have influenced the research questions I am investigating as well as what data I am collecting and my methods of analysis.

Epistemological Orientation of the Study

Crotty (1998) suggested that our epistemological orientation will bring a number of assumptions to our chosen methodology for a study. Crotty suggested that one's epistemology influences the following aspects of the research process: methods, methodology, and theoretical perspectives. According to Crotty, it is important to identify, explain and justify our epistemological orientations and resulting assumptions in order to make our theoretical underpinnings and choice of particular methodologies explicit. By detailing the epistemological orientation of this research, I hope to make explicit my underlying assumptions regarding the nature of knowledge for this study.

Bredo (2006) distinguishes between two different approaches to theories of knowledge: external and internal relations. External relations view the environment as explaining the properties of knowledge. For example, externalists such as behaviorists examine the effect of environmental stimuli on behavior. Behaviorists believe that the environment determines aspects of the mind. Their claims were universal and did not account for individual differences. On the other hand, internal relations were in opposition to external relations. Instead, internalists suggest that knowledge is influenced by the mind and is shaped by language and culture. Internalists reject universal laws of behavior and argue that humans have flexibility in interpretation.

Crotty (1998) likewise categorizes different theories of knowing and argues there are three basic epistemologies: objectivism, constructionism and subjectivism. Different theoretical perspectives, such as positivism, interpretivism, and post-structuralism, stem from these basic epistemologies. An objectivist epistemology holds that meaning and meaningful reality exist apart from any consciousness. In this view, humans can discover universal truths through objectivity. Constructionism opposes this view and holds that truth comes out of our engagement with the world and that there is no meaning without the mind. Crotty states that with constructionism, "meaning is not discovered, but constructed" (p. 9). Meaning comes out of the interplay between the subject and the object of study. Subjectivism, a third epistemology, varies from constructionism in that meaning does not come from an interaction between the subject and object but rather meaning is ascribed to the object by the subject. The object makes no contribution to meaning.

Guba and Lincoln (1994) and Schwandt (1994) provide further description of the constructivist paradigm. Both suggest that constructivists view that there are multiple realities that are socially constructed and alterable. Multiple knowledge can co-exist and each view is equally competent. These social constructions are developed through negotiation and are subject to continuous and ongoing revision. Constructivists believe that there are multiple methods of inquiry and draw a distinction between the methods of natural and social science. In the social sciences, constructivism assumes that the investigator and the object of investigation are interacting such that the findings are jointly constructed through the research process. The constructivist is concerned with the emic point of view and may use methods such as participant observation and case study reporting to present the negotiated, multi-voice view of the researcher and subjects (Schwandt, 1994).

In this study, my view's align with Bredo's (2006) notion of an internalist approach and with Crotty's (1998) view of constructionism. I maintain that knowledge is jointly constructed by the researcher and participants and is not an ultimate truth that has to be discovered. I reject a view of that there is a world of social facts out there waiting to be discovered and instead believe that I engaged in meaning-making between myself and study participants to generate my theory. My theoretical constructions were modified throughout the study as I further interacted with participants and revisited my data during the analysis process. I believe that there are multiple realities which are shaped by the context, culture and language. A different reality may be constructed by another researcher and set of participants or in another context. Like Denzin and Lincoln (1994), I believed it was important to take a naturalistic approach and was a participant observer in the science camp context. I believed this naturalistic approach was essential to engage with participants and gain access to their views of their identities. Through my interactions with study participants, a constructed theory emerged which was modified and shaped through the research process.

Assumptions

I made a number of assumptions in conceptualizing this study. First, I assumed that identity is an important and significant aspect of learning science. I assumed that identity influences such aspects as how we learn, the activities we engage in, our motivations and attitudes about learning the content. As such, I considered that identifying as a learner of science influences learning and was an important area for investigation.

I also assumed that identity as a learner of science could be developed during a short-term program such as a science camp. For this to be the case, identity was assumed to be dynamic, open for change and formed through everyday actions. Studying identity work at a singular science camp program was predicated on short-term, observable changes in students' identities as learners of science. A view of identity as always developing was necessary to detect differences as a result of a science camp program.

A third assumption was that identity is socially situated. Lave and Wenger (1991) and Brown, Collins and Duguid (1989) argued that learning is situated in the activities and affordances of the context. They argued that enculturation into a community of practice was one aspect of learning. Knowledge, in this view, is a product of the activities and situations within the culture of a particular context. Brown et al. (1989) posited that as students participate in a community of practice, they learn the behaviors and norms of the members. They suggested that in doing so, students "pick up the relevant jargon, imitate behavior, and gradually start to act in accordance with its norms" (p. 34). In this study, I adopted Lave and Wenger (1991) and Brown et. al's (1989) view of situated cognition. As identity is one aspect of learning, I considered that identity is situated in the affordances and activities of the context. As students participated in the community of practice at the science camp, I posited that their identities as learners of science would be shaped by the context.

I further assumed that identity is negotiated through social interactions with others. As students engaged in learning conversations to make sense of the science content presented at the camp, it was assumed that their individual identities developed as they engaged in such conversations. Further, it was assumed that learning conversations would shape the group's identity as a community of learners of science. Engaging in conversation would allow group members to take on new roles and position themselves in new ways within the group.

Another assumption was that identity develops through discourse. Gee (2001) referred to a “discursive identity” or a “D-identity” (p. 100). A D-identity is an aspect of identity that develops through discourse with others. According to Gee, a D-identity is recognized through discourse with others. An identity cannot be negotiated in isolation but rather is contingent upon negotiation through dialogue with others. Lee (2007) posited that identity is constantly shifting through and during discourse. I used this notion and assumed that students’ identity work was accessible for interpretation through the discourse that surfaced during conversations in the context of science camp activities.

I further assumed that the changes in learners’ identities as a learner of science were due to the camp program. That is, I made the assumption that the science activities and aspects of the camp were responsible for the changes observed in participants’ identities as learners of science during the study.

A final assumption I made is that science learner identity development during learning conversations can be captured through observations, journaling, and focus group interviews. I assumed that the instruments used in the study measured the intended constructs.

Limitations

This study is limited in multiple regards. The use of case study methodology necessitates looking at the construction of students’ identities in one context. The use of a case study, I believe, was warranted to provide a rich, detailed account of students’ construction of identities in this context. This is especially important given that prior research in science camp contexts has focused largely on survey data to represent students' changing attitudes, motivation, and confidence toward science. Donmoyer (1990) points out that a well-designed case study can add nuanced descriptions and subtleties to a developing theory. There are a number of advantages to using a case study approach; however, in conducting a single case study, I only looked at students' experiences in this specific context.

Another limitation of the study was the purposeful selection of students that were verbally proficient to serve as case participants. As the research question focused on the role of conversation in identity development as a learner of science, I felt it was important to select students that participated in the conversation often and were verbally proficient to ensure that I had adequate data for analysis. However, it is possible that in selecting verbally proficient students I may have limited diversity among participants. That is, the ability to be verbally proficient may have impacts on other aspects science learning. For example, because participation in the science classroom and performance on tests requires verbal proficiency, I may have limited the data collection by selecting participants that have experienced success in the science classroom.

A further limitation of this study was that I investigated the role of conversation in identity development as a learner of science. The methodology used to gain insight into this question made it difficult to tease out whether the conversation or the setting was the main influence on participants' identities as learners of science. The opportunity to engage in a learning conversation is intricately linked with the opportunity to learn in an informal science education setting.

This study was also limited by constraints of data collection methods. Due to the nature of the science camp context, videotaping required that I track students as they engaged with peers in learning conversations. Previous work in museum settings set-up stationary cameras at one exhibit and taped families as they engaged with that particular exhibit (e.g., Crowley, Callanan, Jipson, et al., 2001). However, in the science camp context students were given opportunities to explore the location and collect organisms during the field-based experiences. As they explored the setting, the group status was fluid in that participants engaged with different peers at different moments in time. The group membership was often shifting as new members entered the conversations and others left. Therefore, I was not be able to keep the camera in a fixed position and instead elected to follow the case participants as they engaged in conversations with their peers. Allen (2002) indicated that tracking of the learner throughout the informal science setting might be a limitation when studying learning conversations. Allen argued that the intrusiveness of the researcher when tracking for videotaping might influence the authenticity of the conversations.

There were also methodological limitations due to the lack of sophisticated technical equipment for videotaping in the field. Because a majority of the videotaping took place outdoors, the conditions often interfered with the audio of the tapes. Specifically, there were times during taping were the wind picked up significantly and made the tapes inaudible. On the research cruise, the groups worked so closely that at times, the audio picked up talk from other groups. These conditions, at times, made the tape inaudible and I was not able to decipher the talk for transcripts. Therefore, I was not always necessarily able to capture all of the participants' dialogue during talk within their group. This happened infrequently and my field notes and observations of the videotapes helped me to augment this missing dialogue.

This study is also limited in that identity is situated within the learner. Falk (2009) and others cautioned that identity has historically been a complicated construct to define and investigate in research. Identity is situated within an individual and may be difficult for a researcher to "see" and measure. In this study, I used what Sfard and Prusak (2005) referred to as second and third-person identities to gain access to students' identities as learners of science. I asked the participants to share their stories of developing identities with myself, the researcher. The teachers' accounts of the case participants' were also used in the study and constitute what Sfard and Prusak identify as third-person identities. The data I report here are my interpretations of these second- and third-person identities and what I believed the learners' viewed as their identities. I checked my interpretations through regular conversations with my advisor and through peer debriefings. Leadership personnel and educators at the MSC also provided feedback of my emerging interpretations. I used a member check procedure with study participants to elicit their reactions to my emerging assertions and interpretations. I provide a more detailed explanation of how I will address issues of trustworthiness and researcher bias in the methodology section.

Another limitation of the study is the short-term nature of the science camp program. Participants attended the MSC program for a period of four days. The study was limited in that it considered only the science learner identity development that took place over a four day period. However, investigations of identity have been conducted in museum settings in which visitors are followed only for a period of a few hours (Falk, 2009; Fienberg & Leinhardt, 2002; Stainton, 2002). The science camp program was longer-term relative to other informal learning environments but will still provide only a limited account of science learner identity development.

A final limitation of the study is that I only investigated students' identities as learners of science in the science camp context. Rahm (2007), for example, found that students' identities as learners of science were shaped during afterschool science experiences. However, she questioned whether students would maintain aspects of these identities in the formal classroom. I do not follow-up with students at the school settings to ascertain whether they have maintained aspects of the identities constructed during the science camp program. I viewed that identity is fluid, constructed in social interactions and is situational. Lee (2007) contended that identity is constantly shifting and it is inappropriate to make claims that a student has a "such-and-such identity" (p. 281). In this study, I did not attempt to make claims about students' fixed identities. My presuppositions were such that I expect learners' identities would be shaped by the context and would change over time. The purpose of this study was to look at the inherent opportunities for learners to engage in conversations in the science camp context and the role that such conversations played in science learner identity development.

Summary

In this chapter, I have reviewed background information on informal science education, learning conversations, and middle school learner. I explained the purpose of the study which is to gain insight into the ways in which science learner individual and group identity development of middle school students is influenced during learning conversations at an informal science education camp. I outlined the problem that I investigated and stated the research question guiding the study. I detailed the theoretical framework of identity development and discussed the ways in which identity is negotiated through social interactions and discourse. I described how my personal biography has informed the study as well as the underlying assumptions and epistemological orientation of the study. Finally, I identified the limitations and possible significance of the study.

Chapter Two: Literature Review

Introduction

This study is informed by three bodies of literature. The first body of literature examines identity theory and the various interpretations of identity. The second body of literature examines sociocultural theories of learning and their application to identity and learning in informal science education settings. The third body of literature examines how groups engage in learning conversations in informal learning environments and how these social groups make meaning from exhibit and program content. I combine these bodies of literature to suggest how individual and group identity as a learner of science is shaped through social interactions during conversations in informal learning science settings.

Identity

In this section, I define identity as it has been defined by others and as I have come to conceptualize it, examine various perspective related to identity theory and describe my application of identity as a framework to fit my research question. I also outline my views on what it means to identify as a learner of science.

Defining Identity. Gee (2001) defined identity as becoming and being recognized as a certain type of person. Gee writes, “when any human being acts and interacts in a given context, others recognize that person as acting and interacting as a certain ‘kind of person’ or even as several different ‘kinds’ at once” (p. 99). I adopt a similar view, defining identity as an individuals’ conception of self as well as the ways in which others perceive the individual. I view that individuals have agency in influencing how others view them. Individuals may act and position themselves in certain ways in an attempt to have others consider them as a certain kind of person.

I further believe that the context and situation shape an individuals' identity. A review of the literature on identity suggests that there are two components of identity: core identities and situated identities. Falk (2009), in a theoretical piece, detailed his thinking about these two aspects of identity. Falk distinguished between what he referred to as big "I" identities and little "i" identities (p. 73). In his view, big "I" identities constitute deeply-held identities such as an individual's race, religion, or gender. On the other hand, little "i" identities were constructed when responding to the needs and realities of specific moments and situations. Falk speculated that for most people, big "I" identities do not drive everyday actions. In contrast, little "i" identities are always situated in the moment and are continually constructed as need requires. Falk's ideas about identity are such that individuals have numerous identities which are expressed at different times. From this perspective, identity is viewed as "emergent, rather than permanent; it is something nimble, ever-changing, and adaptive" (pp. 72-73).

Olitsky (2007) and Roth and Tobin (2007) similarly postulated that individuals have numerous identities. Olitsky (2007) referred to categorical versus situational identities. Categorical identities were defined as those that are more permanent identities, such as race or gender. Olitsky (2007) claimed that categorical identities influence, but do not determine, an individual's situational identity. With regard to an identity as a science learner, categorical identities, such as a students' ethnicity, may influence their identity as a learner of science, but the student has agency in determining their identity in social situations. Roth and Tobin (2007) used the terms core and situated identities. Core identities represent those that are relatively stable and are not necessarily altered through social interactions in everyday life. According to Roth and Tobin, situated identities differ from core identities in that they change from one setting to the next and are revealed through interactions with others.

The study by Olitsky (2007) illustrates the idea of situated identities. Olitsky used methods of ethnography to examine students' science learner identity formation. The teacher in the study taught both chemistry and physics throughout the school year. Olitsky referred to the teacher as being "out of field" when she taught physics, an area the teacher perceived as outside her area of expertise (p. 201). From classroom observations, Olitsky concluded that students' science learner identity formation was facilitated when the teacher taught out of field. The teacher was more likely to show her learning process and struggles with the content when she was out of field. Olitsky speculated that these practices lessened the social distance between the teacher and students, reduced the risk of using science language among students, and diminished students' views of science as an elite status group. As a result, students' science learner identity development was enhanced when the teacher was out of field.

The case detailed by Olitsky (2007) reveals the notion of situated identities. Within the same classroom, students expressed different identities as learners of science depending on the situation. During periods when the teacher was in field, the students viewed science as an exclusive status group in which complicated language marked members from non-members. Students were not comfortable asking questions or participating in class when the teacher was in field. When the teacher was out of field, social interactions were more equitable and learners engaged in desirable science learner identity formation. Students were more likely to participate in class and reported greater enjoyment of science when the teacher was out of field. This example demonstrates how the specific affordances of the situation influenced science learner identity formation.

For the purposes of this study, I adopt a view of identities as situated in the realities and affordances of the specific context and moment. That is not to say that there are not aspects of identity which are more stable; however, I am interested in the situated identities that learners construct through social interactions in an informal learning environment. I posit that during learning conversations, in which the context is novel and learners are engaged in joint meaning-making processes, learners' will construct components of an identity as a learner of science. Varelas et al. (2007) speculated that identities are constructed as participants interact in the context of activities. Through engagement in activities, participants jointly construct meanings, roles are taken up, power relations play out, and participants position themselves and one another as they negotiate boundaries. In the context of a science camp, I view students' identities as dynamic and responsive to the activities of the program. As students engage in camp activities, they jointly construct meaning, take up roles and position themselves with respect to the group and the science community.

The National Research Council (2009) also alludes to a distinction between individual and group identity. They posited that both individual and group identity developed during learning conversations in informal science education settings. By group identity, I refer to one's sense of self derived from perceived membership in a social group (Chen & Li, 2009). When we belong to a group, we are likely to derive aspects of our identity from our perception of the group. This is in contrast to individual identity in which an individual is viewed as autonomous and independently motivated (Abrams & Hogg, 2004). The notion of group identity comes from the field of social psychology and has been more recently applied to studies of economics, particularly how perceived group membership drives economic decisions (Ahmed, 2007; Chen & Li, 2009; Solow & Kirkwood, 2002).

A social group can be defined as two or more persons engaged in social interaction who have a relationship with one another, are interdependent, share common goals and perceive that they are part of the group (Chen & Li, 2009). Drawing on this definition, a community of science learners might be considered a social group. The individual learners are engaged in social interaction with one another, have a relationship with one another, are interdependent and share a goal of engaging in science. Research on group identity posits that actions and behaviors are influenced by perceived membership in a group. For example, once a person sees herself as part of a group, she derives self-esteem from group membership and aligns her behaviors with those associated with the group (Chen & Li, 2009). In relation to science learning, once an individual perceives herself as a member of the group of science learners, her self-esteem will develop from membership and she will align her behaviors with those of the group.

The National Research Council (2009) and researchers such as Ellenbogen et al. (2007) have begun to apply theories of group identity to learning in informal education environments. Ellenbogen et al. (2007) suggested that during group conversation in informal learning environments, group members learn about one another, members explore new roles within the group, new power relations play out and the group constructs shared meanings. Group identity is an important construct for learning. That is, an individual's perceived sense of self within the group may influence aspects of learning (e.g., ability to collaborate and learn from others, ability to see oneself as a capable learner).

Identity Theories. A number of theoreticians have offered their diverse views on identity (Gee, 2001; Holland et al., 1998; Kisiel, 2010; Polman & Miller, 2011; Sfard & Prusak, 2005; Wenger, 1998). In this section, I detail each of these theories of identity and the nuanced aspects that differentiate one perspective from another. I apply each theory to the field of science, describing how each theory would shape an individual's identity as a learner of science. I conclude this section by explicating the view of identity that I adopt for the purposes of this study.

Identity and Agency in Cultural Worlds. Holland et al. (1998) explored the development of identities within cultural meaning systems which they referred to as "figured worlds" (p. 49). They described identities as more specifically cultural identities which they viewed as forming in relation to structures in society. They stated, "We focus on the development of identities and agency specific to practices and activities situated in historically contingent, socially enacted, culturally constructed 'worlds': recognized fields or frames of social life" (p. 7). Their view largely focused on the social positioning that individuals engage in when they interact with one another.

The work of Holland et al. (1998) examines how one's identity is influenced by their belonging to a particular culture or group. As Nasir (2007) described, Holland et al. (1998) demonstrated how identities develop in these 'figured worlds' and how identities are shaped by the cultural meaning systems. Throughout the book, Holland et al. offer the story of a woman from Nepal to exemplify their notion of identity. In the example, the Nepal women is invited to the home of one of the authors. To enter the home, the Nepal women would have had to pass through the kitchen of the home, an action that was afforded only to members of higher castes. The woman, not wanting to violate these cultural rituals, climbed a wall and entered the house through the balcony. Holland et al. described how the woman's actions were shaped by her identity in this cultural system. The woman adopted a particular view of herself that was based on her position within this cultural world.

Holland et al. (1998) described four contexts of practiced identities: figured worlds, positionality, space of authoring and making worlds. Figured worlds are the contexts that are socially and culturally constructed through joint production in activities, discourses and artifacts. Holland et al. describe figured worlds as realms of interpretation in which certain characters, acts, and outcomes are favored over others. As applied to this study, figured worlds might refer to the culture of science and the ways in which certain activities, forms of discourse, tools and outcomes are favored in this field. As applied to school science, Carlone, Kimmel, Lowder, Rockford and Scott (2011) suggested that there are various figured worlds that determine what counts in the science classroom and who is considered a good science student. For example, in the figured world of traditional science learning, memorization is favored and smart students are considered those with the most factual knowledge.

Positionality has to do with one's position relative to others within these figured worlds. Positionality is linked to social status, power, privilege, and negotiation. Within a cultural context, certain positions are given greater respect and access due to their privileged status in society (Holland et al., 1998). In the field of science, certain groups have traditionally been granted greater access in this community. Positionality, in this regard, would refer to how a student negotiates their identity based on their perceived position within this system. For instance, a female minority student might not identify as a member of the scientific community given the traditional status of such individuals in this community.

Space of authoring refers to the act of an individual responding and representing oneself to others within cultural worlds. Holland et al. (1998) write that "The world must be answered--- authorship is not a choice--- but the form of the answer is not predetermined" (p. 272). Authoring the self describes how individuals respond to particular situations and their agency within cultural meaning systems. Although certain groups have historically been privileged in the scientific community, an individual has agency in responding to these positional aspects and agency in the identities they construct.

In making worlds, individuals envision new figured worlds that come about through what Holland et al. (1998) referred to as “serious play” (p. 272). Serious play describes social play through which people can develop new competencies to participate in or alter the figured world. These new figured worlds may lend themselves to new activities, artifacts, forms of discourse, and outcomes. In this context of identity, individuals may develop new competencies that prompt identification with the culture of science. Or, new figured worlds might develop with which learners see themselves identifying.

Identity as an Analytic Lens. Gee (2001) established four views of identity that he argued were different aspects of how identities are formed and sustained. These four aspects of identity included: nature-identity (N-identity), institutional identity (I-identity), discursive identity (D-identity), and affinity identity (A-identity).

Nature identities are a state developed from forces of nature (Gee, 2001). In terms of science learning, an N-identity would refer to a learner holding a belief that some students are predisposed to learn and be successful in science. Anderson (2007), in his study of mathematics learners, suggested that some students hold a belief in a math gene in which some individuals are more capable of learning math than others. Such a belief would constitute an N-identity.

Institutional identities are positions authorized by the rules or norms of an institution (Gee, 2001). As a means to conceptualize I-identities, I view that the formal and informal science institutions each have a set of norms and rules which dictate learning in these settings. Formal classroom settings (e.g., public and private schools) operate according to the rules set by the local, state, and national education boards. As a result, learners are often subjected to pre-determined curricula and are assessed using traditional measures. Informal settings, on the other hand, are characterized by different institutional rules and traditions. Experiences in these settings are not developed as part of a prescribed curriculum and are often not formally assessed (Crane, 1994). As a result of these institutional differences, participants in these diverse setting may develop varying identities as learners of science.

Discursive identities are individual traits recognized through discourse with other individuals (Gee, 2001). A D-identity might be that a learner becomes recognized through discourse as a capable learner of science. Brown and Kelly (2007) argued that a learner might take on an identity as a learner of science by accepting or rejecting the use of scientific discourse. In their study with ethnically diverse students, they found that students often rejected the use of scientific discourse as they felt it conflicted with their identity as a minority. Olitsky (2007) summarized that students' use of science discourse and how they use talk with others to position themselves in the community of science can serve as indicators of students' identities as learners' of science.

Affinity identities represent the fourth aspect of an individuals' identity. Affinity identity describes experiences shared in the practice of affinity groups (Gee, 2001). A-identities come from a specific set of practices established within a group. A learner might acquire an A-identity through participation in a community such as the science community. Participation in such a community would dictate that a learner take on the shared practices that characterize the group.

Identity as Narratives. Sfard and Prusak (2005) extended the views of Gee (2001) and Holland et al. (1998) and offer their perspective on identity. Sfard and Prusak (2005) argued that Gee (2001) and Holland et al.'s (1998) notions of identity lack a mechanism as to how one comes to decide "who" or "what" type of person one is. From their perspective, identities are narratives. Sfard and Prusak (2005) offer the following definition of identity, "a set of reifying, significant, endorsable stories about a person. These stories, even if individually told, are products of a collective storytelling" (p. 14). Sfard and Prusak (2005) argued that Gee (2001) and Holland et al. (1998) view narratives as entities through which an identity is represented or described during discourse. Sfard and Prusak (2005) clarify their position, arguing that they are not claiming identity finds expression in stories, rather that identities are stories. Identities, in their view, are "discursive counterparts" of an individual's lived experience (p. 17). Identity-building is equated with story-telling in that as the stories themselves evolve, an individual's identity concurrently evolves as well.

The essence of Sfard and Prusak's (2005) theory of identity is the notion that identities are narratives that are reifying, endorsable, and significant. They posit that the reifying quality of the narrative comes from the use of verbs such as "be, have, or can" rather than "do" and adverbs such as "always, never, and usually" that stress repeated actions (p. 16). Narratives about a person are endorsable if the individual identified indicates the story depicts the actual state of affairs. Finally, significant narratives are those in which any changes to the story influence the storyteller's view of the individual identified.

Multiple identities exist for an individual. Their identity narrative may change depending on the details of the narrative, the person telling the story, and who the story is meant for (Sfard & Prusak, 2005). That is, each narrator may have a different view of identity for an individual. The story a person endorses as true about herself may not be what others see enacted. Therefore, different types of stories about an individual may emerge. A first person identity (a story told by the individual), a second person identity (a story told to the individual) and a third person identity (a story told about the individual to a third party). Sfard and Prusak argued that the first-person, self-told identities are likely to have the most immediate impact on our actions.

In her interpretation of Sfard and Prusak's (2005) work, Luehmann (2009) stated that the most influential narratives impacting an identity are those stories that an individual tells about herself. Luehmann (2009) suggested that the learner's narrative is influenced by significant narrators, people whose opinions and interpretations (of the learner) the learner most values and respects. Luehmann (2009) recommended that, "educational experiences need to offer learners opportunities to recognize their own growth as well as position themselves to be recognized by others as growing---narrating stories of their own learning and development" (p. 53).

Sfard and Prusak (2005) distinguished between actual and designated identities. Actual identities represented the actual state of affairs while designated identities were identities that were expected to be the case either presently or in the future. One aspect of learning, then, was viewed as closing the gap between actual and designated identities. For example, an individual's desire to enter a particular career marks a designated identity. Identity-building takes place as the individual works to close the gap between their actual identity and this designated identity.

As applied to science education, a learner might wish to enter a science career profession or become a lifelong learner of science. As they engage in science activities and possibly choice to take advanced courses in science, the identity-builder is working to close the gap between their actual identity, a science student, to their designated identity, such as a professional scientist or lifelong learner of science. The identity work that the learner engages in takes place through narratives. The individual tells stories about themselves as a science learner (e.g., to parents, teachers, peers) that are part of a collective storytelling (e.g., teachers tell stories about the student). According to the theory detailed by Sfard and Prusak (2005), these stories, and the individual's identity as a learner of science, evolve over time and constitute identity-building.

Identity in a Community of Practice. Lave and Wenger (1991) viewed learning as inextricably linked with identity development. In *Situated Learning: Legitimate Peripheral Participation,* Lave and Wenger postulated that learners must be engaged as legitimate peripheral participants in communities of practice for learning identities to develop. By legitimate peripheral participants, Lave and Wenger considered participation as a way of learning. They maintained that peripheral participation provides initial access that gives exposure to the actual practice. The learner enters the community of practice as a newcomer on the periphery of the practice. As they are absorbed into the culture of the practice, they move toward participation in the central activities that define the community of practice. Their participation proceeds from new-comer to becoming an old-timer as the individual acquires the skills, knowledge, and language for participation in these communities. Through participation in the community of practice, the individual is transformed as well as the practice itself. Identity development occurs as the individual comes to see themselves as members and participants within communities of practice.

As an extension of the work detailed by Lave and Wenger (1991) in *Situated Learning: Legitimate Peripheral Participation,* Wenger (1998) extends thinking about communities of practice and identity work in a second theoretical piece, *Communities of Practice: Learning, Meaning, and Identity.* As human beings, we engage in enterprises with one another which results in a collective learning. Wenger defines a community of practice, stating that “this collective learning results in practices that reflect both the pursuit of our enterprise and the attendant social relations. These practices are thus the property of a kind of community created over time by the sustained pursuit of a shared enterprise” (p. 45). Wenger identified three dimensions of a community of practice: mutual engagement, joint enterprise, and a shared repertoire. Below, I examine each of these dimensions in greater detail.

The dimension of mutual engagement refers to activities and actions members of a community share. Members of the community negotiate the meanings of these activities through social interactions. Within mutual engagement, the diversity and partiality of members results in participants specializing and distinguishing themselves as members within the community. Through engagement in practice, relationships among members of the community of practice develop (Wenger, 1998). Kisiel (2010) provides a simplified account of this dimension, describing mutual engagement as “a set of common tasks that creates coherence within the community” (p. 98).

Joint enterprise refers to the aspects of the community of practice that are negotiated by members of the community. This may include the rules, goals, or requirements for practice within the community, and is continually shaped through negotiation between members (Wenger, 1998). Wenger states that the enterprise is defined by the participants as their negotiated response to the perceived situation.

Shared repertoire is another characteristic Wenger (1998) identifies as constituting a community of practice. Shared repertoire refers to the resources that have been produced or constructed in the community of practice and that have come to facilitate the practice. Kisiel (2010) suggested these resources might include tools, artifacts, definitions, and common experiences that facilitate practice in the community.

Wenger (1998) perceived communities of practice as shared histories of learning. Members of the community, through mutual engagement in jointly pursuing an enterprise, share some significant learning. From this perspective, legitimate peripheral participation can open up the community of practice if it provides access to the three dimensions of the practice. That is, peripheral participation must grant opportunities for mutual engagement with other members, opportunities for the negotiation of the enterprise, and access to the shared repertoire.

The theory of identity articulated by Wenger (1998) postulated that as a community of practice is formed, members engage with one another and come to recognize one another as participants in the practice. The practice necessitates the negotiation of ways of being a person in that community, what Wenger defines as identity.

There are various characterizations of identity: identity as negotiated experience (we define who we are through participation); identity as community membership (we define who we are by the familiar and unfamiliar); identity as learning trajectories (we define who we are by where we have been and where we are going); identity as nexus of multimembership (we define who we are by how we reconcile various forms of membership into one identity) ; and identity as a relation between the local and global (we define who we are by connecting local ways of belonging to broader constellations). Thus, engagement as a member in a community of practice influences the various aspects of an individual's identity.

Wenger (1998) identified three distinct mode of belonging that characterize how identities are constructed in a community of practice: engagement, imagination, and alignment. Wenger defined engagement as active involvement in the process of negotiation of meaning. Nasir (2002) exemplifies engagement through the sport of basketball. Through engagement with basketball, individuals create relationships with other players and learn to work as a team. Together, they develop a shared history of practice (e.g., they build team memories, players roles become routine) and come to see themselves as members of the team and the sport of basketball.

Imagination, the second mode of belonging, can be conceptualized as the activities an individual chooses to engage in and how they envision these activities as fitting into their broader view of self. Wenger (1998) commented that imagination "emphasizes the creative process of producing new 'images' and of generating new relations through time and spaces that become constitutive of the self" (p. 177). Nasir (2002) indicated that individuals engage in imagination when they consider other ways of doing things, generate new scenarios, consider possible trajectories and explore other possible selves. In the context of basketball, players engaged in imagination when discussing ranking of players or visualizing themselves as college or professional basketball players. With increased engagement, the players came to see themselves as situated within the broader community of the sport of basketball.

Alignment refers to individuals connecting to communities of practice through coordinating their actions and energies to a particular practice (Wenger, 1998). Anderson (2007) suggested that mathematics learners engage in alignment when they align their energies within the institutional boundaries and requirements (e.g., followed the rules of school math, enrolled in advanced mathematics coursework as prerequisites for college acceptance). Using the sport of basketball again as an example, Nasir (2002) suggested that alignment becomes part of a player's identity when they align their actions with those of college and professional players. Players watch basketball games and try to emulate the actions of professional players. Such work is what Wenger (1998) would identify as alignment.

Wenger (1998) suggested that various communities of practice can exist and may overlap. When overlap occurs, two separate communities of practice share a common practice but still retain distinct enterprises and practices. Wenger discusses boundary objects, objects that create connections and overlaps between various communities of practice. Kisiel (2010) identified boundary objects as those things, documents, terms, and artifacts that help organize the connections between overlapping communities. The process of brokering can also create connections between overlapping communities of practice (Wenger, 1998). According to Kisiel's interpretation, brokers are defined as those people who facilitate connections by introducing aspects of one practice to another. Brokers introduce appropriate boundary objects and help bridge the different communities of practices.

As multiple communities or practice exist, it is possible for an individual to belong to more than one community of practice. This notion Wenger (1998) defines as multimembership. One way to view identity is as what Wenger refers to as a "*nexus of multimembership"*(Wenger, 1998, p. 149). That is, we define who we are by the ways we reconcile our various forms of membership into one identity. In this regard, the brokering process more specifically helps a learner transfer some elements of one practice in other practices to which they are a member.

Wenger (1998) uses the term, trajectory, to identify access to a community of practice as a full member. Thus, identities are defined with respect to the interaction of multiple trajectories which may diverge or converge. Wenger suggested that trajectories help to incorporate our past and our future in negotiating our present identities. One type of trajectory Wenger identified was a "*boundary trajectory*" which spans boundaries between various communities of practice and helps to link these multiple communities. A boundary trajectory can give rise to coexisting identities of participation across multiple communities of practice. In terms of a learner who has multimembership in different communities of practice, a boundary trajectory would link communities of practice in a way that the learner might come to identify as full participants of both communities of practice. An individual would reconcile and thus connect multiple forms of participation and the various communities of practice to which they belong.

In applying this notion of multimembership, I consider that a middle school learner attending an informal science camp program might be a member of several communities of practice such as a school student, an adolescent and a learner of science (although this list is not exhaustive). The informal science education program may help to broker the boundaries between the learner's memberships in various communities of practice and may help the learner to visualize a new identity, one that connects these communities. In providing boundary objects (such as the tools of science), the informal science education may help in the brokering process to help the learner bridge the many communities of practice to which they belong without abandoning membership to any of these communities. That is to say that the brokering does not require a student to abandon their identity as an adolescent, but instead helps the learner to bridge these communities and negotiate a new identity that connects these communities.

Identity as a Learner of Science. In this section, I discuss how Wenger's (1998) framework can be applied to an individual's identity as a learner of science. To begin, I discuss my views of what it means to engage in the community of practice that is science.

Brickhouse et al. (2002) indicated that historically, research scientists have set the standard for how a learner might engage competently in the science community of practice. They cautioned that this view is flawed in that it imposes a narrow view of what it means to engage in science and creates a science community that is too distant and irrelevant for students. Specifically, they argued that engaging in science can include activities not traditionally identified as scientific. For example, a broader range of science activities might include cooking, fixing a car, gardening, and providing health care. These activities broaden the realm of science participation and make science relevant for students.

I adopt a view similar to Brickhouse et al. (2002), and consider that identifying as a learner of science is not necessarily confined to the tradition notions of science as set by research scientists. I believe that learners can meaningfully engage in science and develop identities as learners of science through everyday activities that are not necessarily situated in research science.

From this perspective, I discuss what it means to identify as a learner of science, framed within Wenger's (1998) characterizations of identity. Anderson (2007) used this framework to consider identity as a mathematics learner. I use his application of identity in thinking about what it might mean to identify as a learner of science.

Anderson (2007) applied the first characterization, engagement, to the mathematics classroom and suggested that through interactions with teachers, peers, and oneself, an individual comes to identify as one who has or has not learned math. In the context of science learning, engagement might be considered a student's involvement in the science classroom or as part of an informal science program. As the student engages in science activities in concert with educators and their peers, they develop relationships and a shared history of practice that shapes aspects of their identity. Through engagement, a learner may come to identify in some of the following ways: as one who does or does not participates in science learning; as one who has or has not learned science; or as one who is or is not capable of learning science.

The second characterization of imagination requires exploring new identities and developing trajectories that extend beyond one's present identity to see oneself in new ways (Nasir, 2002). Anderson (2007) identified imagination in mathematics as the images we hold of how mathematics fits into everyday experiences. These images may include images of ourselves using mathematics in everyday life, envisioning ourselves in using mathematics in our future careers, the role of mathematics in secondary education. Anderson suggested that students who do not seem themselves as needing or using mathematics may develop an identity as one who is not a mathematics learner. As a science learner, imagination might include viewing science as useful in everyday life, planning to enroll in science coursework and developing a trajectory that envisions science as a potential career choice.

The third characterization is alignment and describes how an individual coordinates their efforts and actions with the norms of certain communities or institutions. Anderson (2007) provides an example of alignment, describing students that direct their energy toward studying math because they view math as necessary for post-secondary education. A student who aligns their practices with institutional guidelines for college entrance might indicate that they identify as a math learner. In a similar regard, an individual might enroll in advance coursework, knowing that such science coursework is necessary for college entrance. Individuals may align with the conventions of the scientific community. They may learn to apply scientific methods to investigate a question or they may appropriate scientific discourse as a means to align themselves with this community. Through such examples of alignment, an individual might be more likely to identify or be recognized by others as a learner of science.

Discursive Identity. The various theories of identity detailed above seem to have in common the notion of identity as socially situated. In this view, language and discourse become important for the social negotiation of one's identity. In this section, I review the theory of a discursive identity as applicable to the current study. I begin by reviewing the definition of discourse and then consider various views of a discursive identity.

Gee (1996) defined discourses as "a socially accepted association among ways of using language, other symbolic expressions, and 'artifacts' of thinking, feeling, believing, valuing and acting that can be used to identify oneself as a member of a socially meaningful group or 'social network,' or to signal (that one is playing) a socially meaningful role" (p. 131). Gee (2005) distinguished between "little" d discourses and "Big D" Discourses (p. 7). In Gee's (2005) work, little d discourses refer to language in use. When little d discourses are combined with non-language "stuff" (e.g., actions, interactions, ways of thinking, believing, valuing, use of tools, and use of symbols) to enact a particular socially recognizable identity, a Big D

Discourse is enacted and involved. Gee argued that we use discourse to enact identity at the right time and in the right context to get recognized as a certain type of person.

From his notions of Discourses, Gee's (2001; 2005) theory of identity emerges. Gee (2001) identified four aspects of identity, one of which he labeled a "discursive identity" (p. 100). A discursive identity is defined as individual traits recognized through discourse with other individuals. To exemplify this aspect of identity, Gee (2001) provides an example of a colleague who has been identified by others as charismatic. The property of being charismatic is not something one is born with nor is it something that an institution creates and assigns to the individual. Being charismatic is an individual trait that has been developed and recognized through discourse with others. The source of this trait and the power that determines the property of being charismatic has developed through interactions and talk with others. Through discourse and social interaction, the colleague has come to be seen by herself and others as charismatic.

Gee's (2005) notion of a discursive identity is predicated on social interactions and the use of language. Gee theorized that we use language to get recognized as taking on a certain identity or role and that through language, we build a here-and-now view of ourselves. He suggested that language is used to enact an identity and to get others to recognize that identity. Gee emphasized the notion of recognition, suggesting that any identity that is enacted through language must be recognized by others to constitute an identity. In this way, language is used to enact an identity and have that identity negotiated and then recognized by others.

The work of Brown (2004; 2006) and Brown, Reveles and Kelly (2005) provides a conceptualization of discursive identity in the context of science education. Brown et al. (2005) used the term discursive identity to refer to the ways in which students' identities are negotiated through discourse in the science classroom. Through ongoing exchanges and interpretation of discourse, individuals signal meaning to assist others in identifying them as a particular type of person. As the individual signals meaning through discourse, their identity is socially constructed (Brown, 2006). For example, for an individual to be recognized by other as intelligent, the learner must engage in activities and use discourse in such a way that others come to view the learner as having the property of being intelligent. Brown (2006) suggested that in this way, discourse serves the purpose of indicating who the individual wants to be perceived as.

Brown (2004; 2006) and Brown et al. (2005) investigated the ways in which discursive practices in the science classroom may prompt cultural conflict for marginalized students. Brown (2004) indicated that language can be used to signal group affiliation and membership. For minority students in a science classroom, appropriating scientific discourse was in conflict with their cultural identities. Brown et al. (2005) found that engaging in the discourse practices of science resulted in the appropriation of an identity corresponding to the use of scientific language. For example, some students opposed the use of scientific discourse because they believed it would require abandoning their identity as a minority (Brown, 2004). Therefore, these students denied knowledge of answer, avoided opportunities to use scientific discourse and yielded speech opportunities to their classmates. Brown (2004) identified this as opposition discursive identity status. In this way, students rejected the use of scientific discourse to exhibit their opposition discursive identity status. Students in the opposition discursive identity status continued to use their native genres of discourse as a means to identify with their cultural backgrounds. Brown (2004; 2006) and Brown et al.'s (2005) studies exemplified the notion of discursive identities and the ways students used discourse to position themselves and exhibit a particular identity.

Identity in Informal Learning Environments. Using the various theories of identity and the idea of discursive identities, I describe how informal learning environments might prompt identity work. By identity work, I mean that an individual engages in activities or discourse in which their identity as a science learner is constructed or maintained. The unique characteristics of informal learning environments might be conducive to identity work. I describe three ways that I believe informal learning environments might be particularly fruitful for students' identity work.

First, informal learning environments provide multiple opportunities for social interaction (McGinnis et al., in press). Rahm (2007) indicated that identity, who we are and become, is shaped through each opportunity we have to engage in social interactions with others. Learners often participate in informal learning environments in social groups, either with their families or in school groups. During participation in informal learning environments, learners engage with the artifacts of the context (e.g., the museum exhibits, the content of a science camp) and construct meaning through interactions with their social groups. Varelas et al. (2007) posited that as learners engage in these meaning-making processes, they also develop identities. During these sense-making practices, Varelas et al. suggested that learners communicate with one another, take on a variety of roles and negotiate the goals and meanings that result. In this way, learners' identities are shaped as they negotiate goals, meaning, and roles within the social group. Thus, the learning conversations that participants engage in informal learning environments provide multiple opportunities for social interaction and identity work.

Holland et al. (1998) described how power relations can factor into an individual's identity. Power, status, and privilege, they argued, play a role in one's sense of self in that certain positions are given greater access to resources due to their privileged status. Olitsky (2007) suggests that power might influence students' identities as learners of science. Olitsky writes,

> Science can be experienced as exclusive if the associated group is not perceived as being open to new members, if classroom environments do not afford students' agency in acquiring the relevant attributes for membership, or if students experience negative emotions when encountering this group and the associated language and culture. (p. 203).

Olitsky continued and described how teachers in the classroom can, at times, present science in a manner that is viewed as reserved for an elite status group. As an example, she describes teachers' use of complicated science terminology and dialogue that revolves around a structure of teacher initiation, student response, and teacher evaluation. In a similar regard, Lemke's (1990) work suggested that teachers' use activity structures such as triadic dialogue (teacher questions, student responds, teacher evaluates), lecture and debate to maintain power in the classroom. Through activity structures such as triadic dialogue and lecture, the teacher presents of view of science that is disconnected from the lives of students and portrays a "mystique of science" that makes science seem dogmatic, authoritarian and impersonal. Such science classroom practices might establish a power dynamic in which some students do not come to see themselves as fitting within the practice (Lemke, 1990; Olitsky, 2007).

Informal science learning environments might help to diminish such power relations. Crane (1994) identified that informal learning environments are not developed as part of a school curriculum and are voluntary as opposed to mandatory. Activities in informal learning environments are often non-assessed and non-competitive (Hofstein & Rosenfeld, 1996; Rennie, 2007). Informal learning environments are also guided by the learners' needs and interests.

In a theoretical piece, Luehmann (2009) identifies the unique characteristics of what she calls "nontraditional learning settings" and how these characteristics might mitigate power relations and promote identity development (p. 61). She suggested that these learning settings are independent of the school which results in decreased accountability and constraints such as standardized tests and class periods of set times. In such settings, educators can serve as mentors rather than assessors and evaluators which results in a supportive space for students. Further, students had freedom from pre-defined cultural expectations related to classroom roles and procedures. Without the traditional roles and procedures of the classroom, students had opportunities to share power with teachers. Luehmann believed that these features of nontraditional learning settings resulted in a low-stakes and safe environment which afforded students greater agency to experiment with and try on new identities such as the self as scientist.

I adopt a similar view and believe that the unique characteristics of informal learning environments help to diminish power relations that might be more prevalent in formal classroom environments. The non-assessed and non-competitive nature of informal science education contexts may provide a safe and supportive environment for identity development as a learner of science. Thus, these environments might be more conducive to students' developing identities as learners of science.

A second way informal science education may further mitigate power relations and support identity development as a learner of science is through opportunities to engage in learning conversations with peers. Previous work on learning conversations has largely focused on adult-child interactions in museum-like settings (Ash, 2003; Crowley, Callanan, Jipson, et al, 2001; Palmquist & Crowley, 2007). The opportunity to converse with peers in science camps might further promote identity work during learning conversations. Rogoff (1998) suggested that peer relationships are typically more equitable than relationships with adults. Rogoff postulated that similarity of status is important for social interaction that prompts change. She asserted that adults inherently exert power over children which may lead children to abandon their views as they believe their ideas cannot compete with adults. Learning conversations in peer group my provide students with more opportunities to consider new identities than adult-child conversations.

A third and final aspect of informal learning environments that may support identity work as a learner of science is through access to resources and the tools of the scientist. Luehmann (2009) speculated that nontraditional learning settings may offer rich identity resources and ways of engaging with the culture of the new practice. As an example, Luehmann described that the opportunity for students to wear lab coats and goggles, use microscopes and micropipettes may prompt students to consider the identity of self as scientist as they work in authentic settings using authentic tools of science. In the science camp setting, learners have access to many of the authentic tools of science. They use oceanographic equipment such as Van Dorn bottles, otter trawls, plankton nets and refractometers to collect data on the research cruise. In the lab, they were goggles and learn how to use a microscope for viewing plankton. The use of these authentic tools in the informal science education camp context may help to shape and facilitate identity development in these settings.

Sociocultural Perspectives on Learning

Theories of identity are an extension of sociocultural theories of learning. In this view individuals' identities are constructed during social interactions and in the context of cultural systems. Holland et al. (1998) theorized that views of self are socially constructed and that culture shapes the dynamic self. They conceptualized identities as products of social and cultural interactions. In a similar regard, Brown and Kelly (2007) and Nasir (2002) adopt a sociocultural perspective in studying identities and view identity as developed through interaction and tied to human action and cultural meaning systems.

Sociocultural theories of learning are often associated with the work of Russian psychologist Lev Vygostky. Vygotsky's work sought to identify higher psychological processes that distinguished humans from other animals (Siegler & Alibali, 2005). Vygotsky (1978b) contended that these higher psychological processes stemmed from social interactions that take place through the use of language and other cultural tools. Thorne (2005) described that Vygotsky was skeptical of research that failed to account for the influence of the social context on development. Vygotsky's (1978b) approach incorporated interactions in the social environment as an essential element of a child's development. In this section, I provide a brief summary of the sociocultural theories of cognitive development and the basic tenets associated with the approach.

Developmental Mechanisms. Vygotsky (1978b) posited that developmental change occurs through the internalization of socially shared processes which occurs at two levels: the intermental (or interpersonal) level and the intramental (or intrapersonal) level. The intermental level precedes the intramental level and describes interactions that take place between people. The intramental level is secondary and represents processes that occur within the individual (Siegler &

Alibali, 2005). As a means to exemplify this notion, consider a vignette presented by Falk and Dierking (2000). Falk and Dierking described a father and his six-year old daughter visiting a science museum exhibit about animal hearts. At the exhibit, the father and daughter participated in a conversation in which the father read the labels to the child and prompted her to consider the size of their family dog's heart. The nature of the conversation is such that the father provides scientific background information to the child, makes a personal connection using the family dog and responds to the daughter's questions. The interactions between the father and the daughter constitute the intermental level. As the daughter grasps an understanding of animal hearts, the process becomes internalized, occurring at the intramental level. This particular example of a learning conversation between a father and his daughter demonstrates how sociocultural theories of learning are relevant to interactions between learners in informal learning environments.

Zone of Proximal Development. Vygotsky (1978b) identified the zone of proximal development as the distance between an individual's actual developmental level and their potential level given assistance from an adult or more competent peer. Vygotsky (1978a) stated, "The zone of proximal development defines those functions that have not yet matured but are in the process of maturation, functions that will mature tomorrow but are currently in an embryonic state" (p. 38). Cole (1985) described the zone of proximal development through an example of the practice of weaving in a south-central Mexico society. Novice weavers participated in activities under the tutelage of an adult. During the novice stage, the adult interfered often, up to 93% of the time to offer guidance. In subsequent attempts, the frequency of adult assistance declined until the novice could sufficiently complete the weaving task on their own. In this example, knowledge of weaving activities was transferred from the adult to the child and took place within the zone of proximal development.

Astor-Jack, Whaley, Dierking, Perry, and Garibay (2007) detailed the relevance of the zone of proximal development to learning conversations in informal learning environments. They described,

> These ideas are particularly pertinent to understanding the socially mediated processes of learning in museums, since the museum experience *is* the practical activity accompanying the speech that occurs between visitors as they interact and think about the experience. In many situations, this social mediation encourages the individual to broaden her ZPD and develop beyond her capacities; and serves as a form of distributed meaning-making since understanding often resides within the group, rather than any one individual. (p. 218).

In this view, learning conversations might broaden a learner's zone of proximal development in that they are able to move beyond their individual capacity through collaboration with the group. The shared meaning-making that takes place during group learning conversations in informal learning environments may serve as scaffolding that moves the learner beyond their current developmental level.

Language and Cultural Tools. Vygotsky (1978b) viewed language and cultural tools as mediating factors in development. He considered language an important social tool for social interaction. Children use language to communicate with adults and peers as well as mediate their own mental abilities through self-talk, such as acquiring and remembering information and organizing their behaviors (Siegler & Alibali, 2005). Cultural tools also contribute to development and are classified as either psychological or technical. Psychological tools, such as language, are used for thinking and to organize information. Technical tools, such as a hammer, are used to physically act on the environment.

The use of language and cultural tools are implicated in shared learning conversations that take place in informal learning environments. Astor-Jack et al. (2007) described that groups not only use language to interact in museums, but also use nonverbal modes of communication, such as gestures and emotions. In this sense, both language and nonverbal forms of communication serve as tools for engaging in group sense-making practices in informal learning environments. Ellenbogen, Luke, and Dierking (2007) theorized that the museum itself can serve as a sociocultural tool for family groups. They suggested that the museum setting can serve as a tool for family identity building.

The Use of Language for Science. The use of language is an essential aspect of science. Through language, scientists can engage in critical elements of scientific development such as discussing emerging theories, debating competing claims, and collaborating to refine or extend ideas. In this section, I discuss the use of language in science and particularly the role of conversations between scientists. In doing so, I hope to convey that learning to talk science is an important aspect of science learning and necessary for access into the community of science.

Gallas (1995) argued that scientific discovery is rooted in scientists engaging in conversation with their colleagues. She noted the significant role of talk in the development of scientific discovery and suggested that scientists engage in scientific discourse both formally (e.g., in the laboratory) as well as informally (e.g., during a lunch conversations). Scientific theories are socially constructed through interpersonal exchanges as well as interactions with the materials and tools of science.

Latour and Woolgar (1986) provide a detailed account of how scientific knowledge is socially constructed in a laboratory. Latour and Woolgar posited that social interactions influenced the process by which scientists make sense of their observations. In their ethnographic study of a laboratory at the Salk Institute, one of the researchers (Latour) elected to become part of the laboratory for two years and to follow the daily practices of scientists working in this lab. Latour analyzed the conversations and discussions between the scientists in the lab and the ways in which they influenced the scientists and their work. The goal of the investigation was to understand scientific culture and the ways in which scientific knowledge was socially constructed. Their argument was that the dichotomy between the scientific realm and the social world does not exist and instead the production of scientific fact is socially mediated and constructed.

Latour and Woolgar (1986) describe the process of a scientist developing an assertion. They claimed that scientists interact with others through conversation and writing to convince others of their assertions. Latour and Woolgar write, “In short, the objective was to persuade colleagues that they should drop all modalities used in relation to a particular assertion and that they should accept and borrow this assertion as an established matter of fact, preferably by citing the paper in which it appeared” (p. 81). Their statement points to one of the uses of language for advancing scientific theory and knowledge. By engaging in conversations and writing publications, scientists use language to advance their theory and have it recognized and accepted within the scientific community.

As another example of the socially constructed nature of science, Latour and Woolgar (1986) described the ways in which scientific facts are created or destroyed during conversations in the laboratory. They indicated that through informal conversations that took place in the laboratory, arguments were modified, reinforced or negated. Latour and Woolgar referred to four types of conversational exchanges that occurred between scientists during informal conversations in the laboratory. The first type of exchange between scientists in the laboratory featured references to what they described as known facts. Latour and Woolgar suggested these types of exchanges were frequent and usually occurred only when known facts were relevant to a current debate. A second type of exchange included utterances that were necessary for practical activities. For example, scientists may ask questions and make statements such as, "How many rats should I use for the control" (p. 161)? These types of exchanges make reference to the correct way of doing things. A third type of exchange focused on the generation of scientific theory. As an example, Latour and Woolgar detail a discussion between two scientists in which they are discussing a theory related to the absence of a physiological role of Thryotropin-releasing hormone. Finally, a fourth type of exchange featured discussion about other researchers. Scientists engaged in conversations to evaluate other researchers when considering the arguments of a particular paper.

Latour and Woolgar's (1986) study provides evidence about the use of language for the advancement of scientific knowledge. Scientists use language in writing and conversation to advance their theories and persuade others to accept their arguments and assertions. Scientists further engage in informal discussions and conversations to create and destroy facts, discuss practical activities, consider scientific theories, and evaluate other scientists. Latour and Woolgar's work points to the importance of language in the community of science.

Watson's (1968) autobiographical account of the discovery of the structure of DNA provides a case description that helps to exemplify the notion of science being socially mediated and developing through conversations between scientists. As one of the scientists involved in the discovery of the structure of DNA, Watson details his personal account of the development of the theory. He indicates that the discovery of DNA was a collaboration primarily between five scientists: Maurice Wilkins, Rosalind Franklin, Linus Pauling, Francis Crick and James Watson. In his book, Watson discusses how the theory of the structure of DNA advanced through collaboration between the scientists. Watson describes conversations between the scientists, specifically the many informal social interactions between himself and Fracis Crick during which they discussed their developing theory. During these conversations, the scientists would discuss their emerging assertion and evolving theories. The scientists rejected theories that did not hold and helped to advance theories that held promise. Watson also described how work from other scientists contributed to the theory. For example, Watson indicated that contributions from Rosalind Franklin helped their thinking about the DNA structure. Her x-ray crystollagraphy images of DNA helped in determining that the structure of DNA had to have a sugar phosphate structure on the outside rather than in the center. Watson's account points to the pervasiveness of talk and conversation in the development of a scientific discovery.

Language in Science Education. Because language and conversation is an integral feature of doing science, learning to talk science is an important aspect of science education. Sociocultural theories of learning view language as a mediating factor for development. The use of language in science education can occur on both the intramental and intermental levels. On the intramental level, the learner may use science language through self-talk as they acquire and organize scientific language and check their understandings. On the intermental level, learners may engage in scientific discourse with others such as their parents, teachers and peers. Through the use of language in science education, learners may advance their thinking within the zone of proximal development.

Lemke (1990) argued that science education is about learning to talk science. The main argument of Lemke's book was that science is a social process and that scientific findings and argument only become relevant when they are shared in the community of science. He continued and stated that like the field of research science, teaching and learning science are also social processes in which language is used to communicate meaning within the community.

According to Lemke (1990) science has its own specialized language. It has certain grammatical preferences such as passive voice, abstract nouns in place of verbs, and verbs of abstract relations in place of verbs of material action. He suggested that the specialized language of science has preferred figures of speech (e.g., analogy) and rhetorical patterns (e.g., thesis-evidence-conclusion). Lemke believed science talk happened both verbally, through discourse, as well as non-verbally through reading and writing texts. In talking science through verbal discourse as well as reading and writing, he stated that talking science meant observing, describing, comparing, classifying, analyzing, discussing, hypothesizing, questioning, challenging, arguing, designing experiments, following procedures, judging, evaluating, deciding, concluding, generalizing, reporting, writing, and lecturing. Additionally, science has its own specialized forms of writing including: lab reports, experiment reports, and documentation of theories. These specialized texts are methods of organizing information that are specific to the field of science. Lemke (1990) argues that one aspect of learning science is coming to understand the specialized language and texts of science.

Lemke (1990) identified that science dialogue has an organization pattern or an "activity structure" (p. 98). An activity structure is defined as a socially recognizable sequence of actions. The activity structure has parts, a defined type (e.g., teacher question, student challenge) and these elements are related to one another (e.g., teacher evaluation to student answer). Activity structures are completable, meaning they have a defined end which signals a sense of closure to the activity. They are also repeatable and can be interrupted and resumed later. Lemke recognized that activity structures could be everyday or special. Specialized activity structures are often technical and performed by specialists. A special activity structure might include writing a medical report, cataloguing library books, or drawing weather maps. On the other hand, everyday activity structures might include talking on the phone, telling a story, or writing a letter. One activity that Lemke argues is prevalent in school science is the activity structure of triadic dialogue. Triadic dialogue is an activity structure that involves the following exchange:

[Teacher Preparation]
Teacher Question
[Teacher calls for bids (silent)]
[Student bid to answer (hand)]
[Teacher nomination]
Student Answer
Teacher Evaluation
[Teacher elaboration].

Other examples of activity structures include lectures, debates, summary monologues and side talk.

Lemke's (1990) main point was to demonstrate how these activity structures (structures for social interaction) together with thematic patterns create the meanings that are understood in the classroom. Lemke wrote,

> Science dialogue, then, has two patterns: an organizational pattern, represented by its activity structure, and a thematic pattern. In all dialogue there are at least

> two different things going on. First, people are interacting with one another, move by move, strategically playing within some particular set of expectations about what can happen next (the activity structure). But they are also constructing complex meanings about a particular topic by combining words and other symbols (the thematic pattern). (p. 13)

The thematic pattern is often considered a priority in the science classroom, but Lemke points out that it is constructed through social interaction. Therefore, the content meaning (thematic pattern) is inextricably linked with social interaction (activity structures).

Lemke (1990) details his notion of thematic patterns of science language. He argued that language is not just vocabulary and grammar but rather a system of resources for making meaning. For example, a student may know the definitions for words such as ‘electron,’ ‘element,’ and ‘orbital’ but that does not necessarily suggest he can connect these words or describe their underlying conceptual link. Another aspect of learning science, then, is making meaning and understanding the patterns that connect words. Science language is both understanding the words and how to combine the meanings of different terms in relation to one another and across contexts. Lemke argued that talking science is about learning the underlying thematic patterns that combine the meanings of these words. As science educators, we want students to construct the essential meanings of terms and be able to apply them flexibly depending on the situation, argument or problem.

In Lemke’s (1990) view, learning to talk science is about learning these underlying thematic patterns. The information conveyed in the science classroom must be made sense of according to a thematic pattern. The meaning must fit into some thematic pattern in order for us to make sense of the word and apply it in new contexts. Lemke defined thematic meaning as the shared semantic patterns common to all the different ways of saying the same thing. When there is more than one thematic pattern that talk can be fitted in to, different semantic meanings result and the various meanings can be in conflict. This is particularly relevant for students in the classroom. Students may take what a teacher says and fit it into a different thematic pattern. As a result, a different semantic meaning emerges which is in conflict with the intended meaning of the teacher. Everything the teacher says can mean one thing to the teacher and another to the student.

In connecting the idea of thematic patterns with the notion of activity structures, Lemke (1990) posits that the form of social interaction used to convey information can result in conflicting semantic meanings for students. For example, when teachers use lecture or triadic dialogue, activity structures that are unfamiliar to students, students use their own language to generate an interpretation that may be very different from the teacher's intended meaning. Lemke recommended that teachers provide students with new ways of talking about scientific topics. In order for students to learn to talk science, teachers must make connections between scientific thematic and the ways students already talk about a topic.

Other researchers in science education have further articulated the use of language in science education. Kelly (2007) reviewed research on discourse in the science classroom and echoed the views of Lemke (1990). Kelly (2007) contended that learning science is about students coming to know how to use the specialized language of science. He further argued that students should have opportunities to engage in discourse and conversation to make sense of the science content presented in the classroom. Lee and Fradd (1998) examined discourse in the science classroom with regard to students from diverse backgrounds. They identified that one aspect of science learning is talking science and using scientific discourse. Lee and Fradd framed issues of access and equity in science education and claimed that traditionally, it has been assumed that students will understand and learn science when the teacher presents the content in scientifically appropriate ways. This view fails to incorporate students' literacy, language and cultural backgrounds. They suggested culturally congruent practices which are based on shared languages and cultures between teachers and students. Like Lemke (1990) and Kelly (2007), Lee and Fradd (1998) prompt a consideration of the ways we use scientific discourse in the classroom.

The importance of language and discourse in the classroom has been recognized and incorporated in to several reform documents for science education. For example, in *Science for All Americans*, the American Association for the Advancement of Science (1989) listed talking science as an objective for developing scientific knowledge. In the *National Science Education Standards,* the National Research Council (1996) recommended teacher "orchestrate discourse among students about scientific ideas" (p. 32). They suggested promoting different forms of communication (e.g., spoken, written, pictorial, graphic) to engage students in science talk. More recently, in *Taking Science to School,* the National Research Council (2007) recommended teaching students the norms of scientific argument, explanation and the evaluation of evidence. In informal science education settings, the National Research Council (2009) recommends the use or argument (strand 2) and participation in learning practices with others using scientific language (strand 5) as goals for science learning.

Sociocultural theories of learning point to the importance of language and engagement with others for learning. Particularly in the field of science education, the work of Lemke (1990) defines science talk and what it means to learn the specialized language of science. Researchers such as Kelly (2007) and Lee and Fradd (1998) similarly adopt this view and suggest that one aspect of learning science is learning to speak science. Several reform documents have recognized the importance of language and discourse for learning science. Reform recommendations from the American Association for the Advancement of Science (1989) and the National Research Council (1996; 2007; 2009) include aspects of science discourse in their objectives for science learning.

Cultural Norms. Sociocultural theories of learning focus on how normative behaviors and activities within a cultural influence cognitive development (Siegler & Alibali, 2005). The cultural norms and practices influence the knowledge that is valued in a culture as well as the activities in which children engage. Kantor, Miller, and Fernie (1992) described how literacy meanings in a preschool classroom were influenced by the values, practices, and routines of the teacher and students. The teacher and students were viewed as a community that established a common culture through their everyday routines and interactions which influenced how students developed particular understandings about literacy. In terms of informal learning environments, the specific meaning making of content depends on the particular cultural norms and practices of the community or group.

Concluding summary. Sociocultural theories of learning provided a useful lens for considering social interactions in informal learning environments. As Falk and Dierking (2000) observed in museum settings, “People spend a majority of their time in conversation, asking questions, answering questions, gesturing, and the like. Adults ask children questions, children ask adults questions, children interact with one another, and adults do likewise” (p. 45). They suggested that visitors to museums engage in sense making through social interactions with one another and that meaning-making is distributed among the group. Ash (2003) framed her discussion of learning conversations within a sociocultural framework, suggesting that the social group is engaged in activity, the social group is collaborating, and the activities are mediated by tools, signs, people, symbols, language and actions. In the next section, I describe how identity as a learner of science might be shaped during these social processes that take place during learning conversations.

Learning Conversations

The notion of learning conversations in informal learning environments is grounded in sociocultural theories of learning in which learning is viewed as a "joint collaborative effort" (The National Research Council., 2009, p. 33). Crowley, Callanan, Tenenbaum, and Allen (2001) indicated that previous research in informal learning environments focused on nonverbal behaviors such as the length of time visitors engaged with an exhibit. A new line of research in informal learning environments shifts away from such measures and examines how visitors interact in these settings. This research draws on sociocultural theories of learning and are referred to in the literature as learning conversations. The National Research Council (2009) commented that research on learning conversations has added an important thread to discussions on learning in informal science education settings. The examination of learning conversations has shifted the focus away from the individual to the group as a unit of analysis.

The literature on learning conversations has primarily been situated in the context of museums. As groups visit museums, they collaborate and participate in the joint negotiation of understanding and meaning (Allen, 2002). Through learning conversations, explanations are constructed and revised (Crowley, Callanan, Jipson, et al., 2001). Learning, in this view, is not only an outcome, but also a process in which the group attempts to interpret exhibits through meaning-making (Allen, 2002; Leinhardt, Crowley, & Knutson, 2002).

Zimmerman, Reeve, & Bell (2009) provided a characterization of meaning-making in the course of learning conversations. They framed meaning-making within constructivist theories and considered how people construct an individual and shared understanding of new information. Individuals within the group contribute to the conversation as part of a larger negotiation for meaning. Ash (2003) similarly explained that group conversations are opportunities for the co-construction of knowledge by various members of the group engaged in activities together. The conversations that take place within the group support each individual's museum experience. Each member of the group contributes to the joint meaning-making activity as they elaborate with stories and shared experiences (Fienberg & Leinhardt, 2002).

Family Learning Conversations. Previous research on learning conversations has predominately focused on family groups in informal learning environments. Ash (2003) commented, "Museums are places where families play, talk, and learn from each other" (p. 138). Members of the family group support one another's museum visit experience.

Family groups visiting museums have been found to follow a predictable pattern. Family members tend to explore and acquire information for themselves initially and then report back to their family to exchange relevant and interesting information (Ash, 2003; Ellenbogen, 2002). As families exchange information, they construct joint meanings and support the learning of the group (Astor-Jack et al., 2007). Knowledge is distributed among members of the group and each contributes uniquely to the construction of meaning (Ash, 2003). Families also have shared experience, beliefs, and values that influence and enhance the conversation (Ellenbogen, 2002; Falk and Dierking, 2000). For instance, members of the family group share stories that draw on the shared experiences of the group. These shared experiences help each member to make sense of the science content (Falk and Dierking, 2000; Zimmerman et al., 2009).

Investigations of family conversations have looked specifically at the ways parents interact with their children during museum visits. Ash (2003) identified that previous research on family conversations has looked at how parents assist children's scientific reasoning, the role of parent-child explanations, and categories of science content. Crowley, Callanan, Jipson et al. (2001), in a study of parent-child interactions at a children's museum, found parents scaffolded the museum visit experience for children. They encouraged children to participate in talk, select and encode information, and generate evidence. Zimmerman et al. (2009) reported similar results, concluding that parents demonstrated for children how to use evidence, directed children's attention to relevant aspects of the exhibit, and provided connections to prior knowledge and experience. Family members used their prior knowledge and experiences to make sense of the material presented in the exhibit through such strategies as shared remembering, storytelling, joking and the use of analogies. These strategies helped parents scaffold learning for the children during the museum visit.

The literature on family learning conversations informs the current study in a number of ways. Previous research on family learning conversations provide a general account of how groups engage in social interactions to make meaning of exhibit and program content. These studies offer an initial understanding of how groups might engage in conversation in a science camp setting. They further highlight the ways in which members of the group might support one another's learning. Although these studies focused exclusively on adult-child interactions, they suggest that adults used a number of strategies to scaffold children's learning. Still needed are studies that investigate the nature of peer conversations and the strategies that peers might use to support learning among group members.

Peer to Peer Conversations. Investigations of conversations between peers in the literature has largely been lacking (Astor-Jack et al., 2007; Kisiel, 2010). Rogoff (1998) defines a peer as an individual of roughly equal status such as a neighbor, classmate, or sibling. The few investigations of peer to peer conversations have reported mixed results. In a study of learning conversations at a museum, Crowley, Callanan, Jipson, et al. (2001) observed that children engaged more meaningfully with exhibits when they visited with parents than with their peers. Through learning conversations with parents, children's exploration with evidence was longer, broader, and more focused than explorations of evidence with peers. Parents helped children select and encode relevant information and generate evidence. Crowley, Callanan, Jipson, et al. indicated that children produced more co-generative talk when visiting museums with parents. On the other hand, they found that when children participated with peers, the conversation was more likely to be dominated by one child.

The results reported by Crowley, Callanan, Jipson, et al. (2001) contrast with those of Falk and Dierking (2000). They suggested that conversations between students were likely to be more focused than those with adults. Children also reported a preference for listening to information provided by peers over listening to an adult museum docent. The study reported by Crowley, Callanan, Jipson, et al. (2001) also diverges from the general notions of peer collaboration articulated by Rogoff (1998). Rogoff suggested that collaboration with peers leads to a more equitable relationship in which there is greater reciprocity in thinking through discussion and cooperation.

Peers transform their participation as they share activities and adopt various leadership and responsibility roles.

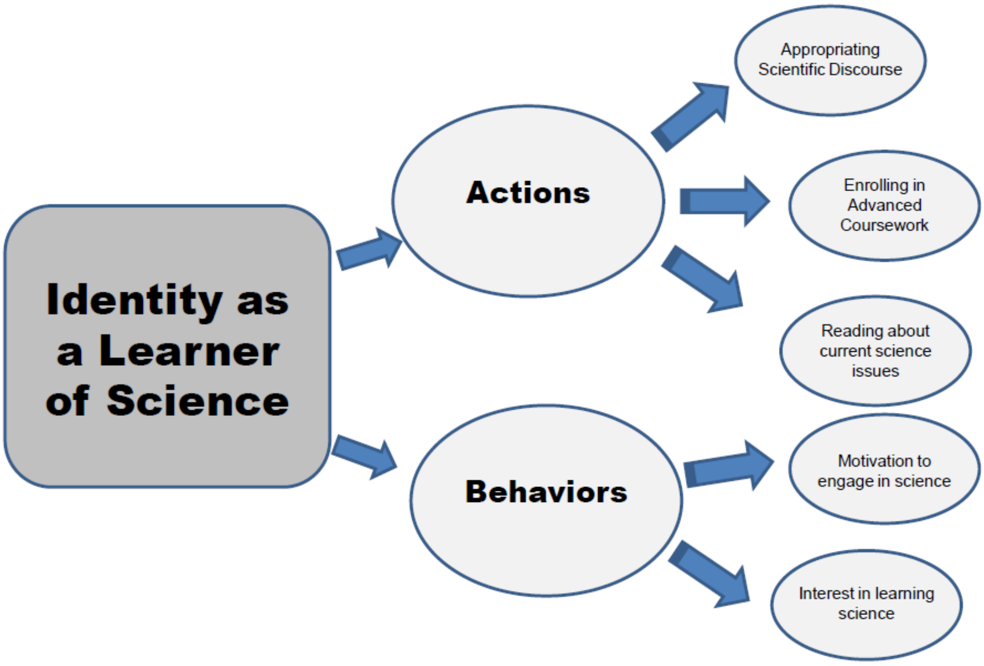
Theoretical Perspective of the Study

In this section, I combine originally the three streams of literature to articulate the theoretical grounding of the study. I discuss the socio-cultural aspects of the camp which lend themselves to learning conversations. During these learning conversations, middle school participants engage in discourse during which discursive aspects of their individual and group identity as a learner of science are shaped. The unique characteristics of an informal science education camp offer affordances that may guide this process of identity development as a learner of science.

Identity in this study was defined as becoming and being recognized as a certain type of person (Gee, 2001). This study focused particularly on discursive identity, defined as individual traits recognized through discourse with other individuals (Gee, 2005; 2011). The construct of identity is very broad; as a means to focus my analysis of identity, I collected data specifically with regard to participants' identities as a learner of science. My analysis of participants' identities as learners of science was based on their responses to how they portrayed themselves, rather than using a priori categories such as ethnicity, primary language spoken and other factors.

I believe that identity development as a learner of science is an important area of investigation. Our identities drive our actions and behaviors and influence our motivations and interests (Brickhouse et al., 2000; NRC, 2009). How one identifies as a learner of science influences the practices the individual engages in as well as the trajectories available to the learner. Learning and achievement are enhanced when students build strong identities as learners of science (Nasir, 2002). It further influences motivation and interest. An individual who identifies as a learner of science is likely to engage in science learning and possibly even choose science as a career. The importance of an identity as a learner of science is exemplified in Figure 1.

Figure 1. The influence of an identity on an individual's actions and behaviors related to science learning.

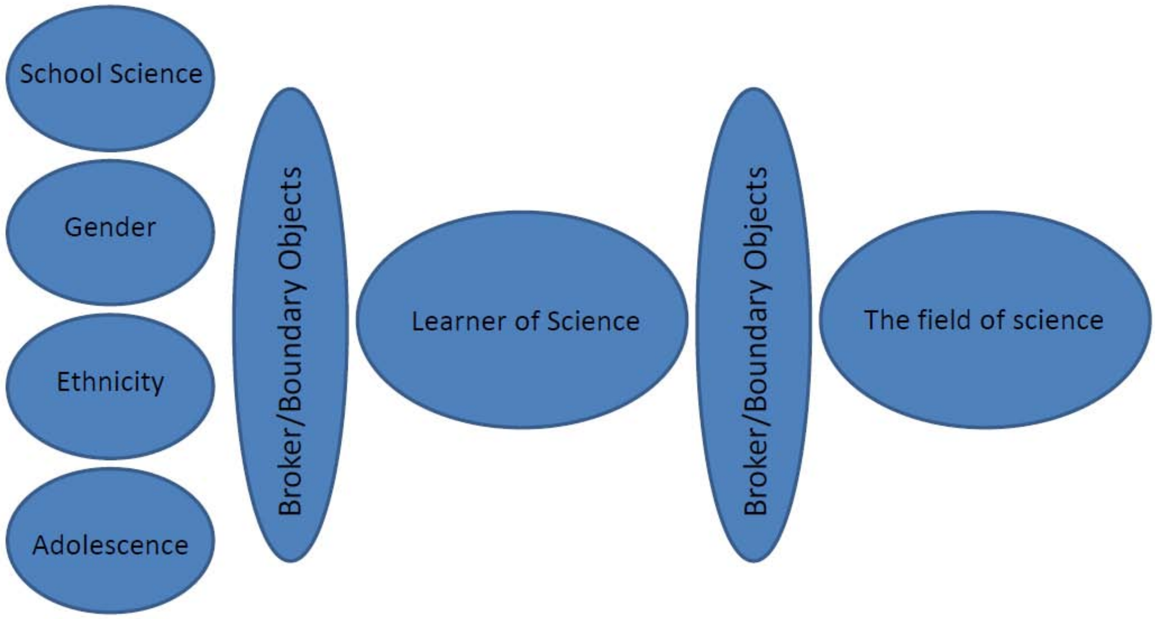


Students' identities as learners of science have largely been framed within the context of school science (Brickhouse et al., 1999; Olitsky, 2007). However, I view that identity is dynamic and situated in the specific affordances of each context. I believe that informal science education contexts may influence students' views of themselves within the context of learning science. In this regard, their identity may shift from that of a school science identity to an identity as a learner of science. The unique aspects of informal science education settings may positively influence an individual's identity as a learner of science.

Before describing the ways in which an informal science education camp may influence learners' identities, I will define my use of identity, drawing on the theories of identity articulated earlier in this chapter. I draw largely on Wenger's (1998) framework of a community of practice to consider what it means for an individual to identify as a learner of science. Through participation in these communities of practice, learners engage in mutual practice, imagine and consider other identities, and align their efforts to those of the community. Identity might be expressed through the actions of the individual, or might be represented in their discourse.

Wenger (1998) contended that individuals can participate in multiple communities of practice at one time. That is, an individual may have multimembership in numerous communities of practice such as a school science identity, an identity as a teenager, an identity as a female, or an identity with a particular ethnic background (to name a few). The learner must negotiate these multimemberships and imagine themselves as full members in the community of practice. The process of brokering helps to connect the boundaries of these various communities. In terms of learning science, the various communities to which the learner belongs must be connected for the individual to imagine a trajectory of full membership in the community of science learners (Figure 2).

Figure 2. Theoretical model of boundary objects and brokers in communities of practice.



Brokers and boundary objects help to negotiate the brokering process. In the context of the informal science education camp, the educators and tools of science serve as brokers and boundary objects that guide learners in viewing themselves in the community of practice of a learner of science and possibly even eventually in the community of science.

Wenger's (1998) account of communities of practice and the process of brokering lacks a mechanism by which this process may take place. Wenger suggests that the use of boundary objects such as tools may aid in the brokering process. My argument further examines the brokering process and posits that language and engagement in conversation could be a mechanism for the brokering process. As learners engage in conversation with their peers and MSC educators as well as the tools of science provided at the informal science education camp, they may begin to connect their membership in various communities of practice and visualize an identity that is a nexus of multimembership.

In speculating about the role of language in the brokering process, I posit that discursive identities are an important notion to explore. I adopt Gee's (2001; 2005) notion of identity and view that individuals use discourse to enact a particular identity in a given context. As Brown (2004; 2006) and Brown et. al's (2005) work pointed out, some students may engage in the brokering process and begin to connect various communities as was evident in their discursive identities. However, for some, the two communities were seen as conflicting and some students rejected the use of scientific discourse as evident in their discursive identities.

Wenger (1998) mentions issues of marginality but does not expand in detail on the notion of marginality with regard to identity. I draw on Holland et al.'s work (1998) and consider that some forms of membership are afforded greater privilege and power in the society of science than other communities. Such privileging and power in society might influence an individual's identity as a learner of science depending on how they view their position in these groups. Carlone and Johnson (2007) argued that a view of identity opens up new ways of viewing science teaching and learning and to ask questions about the kinds of people that have been promoted and marginalized by the practice. Marginalization of certain groups may lead to trajectories of participation that do not lead to full membership. Polman and Miller (2010) suggest that positioning is an aspect of marginality. Categories of social identification "thicken" or "accrete" on individuals as they repeatedly position themselves or are positioned by others as belonging to a particular category (p. 884). Individuals that are from backgrounds that have been historically underrepresented or marginalized in the community of science have additional boundaries to negotiate in entering the community of practice that is science and science learning.

I further use the work of Gee (2001) and Sfard and Prusak (2005) for methodological considerations. Gee (2001) suggested that one component of identity is a discursive identity. Discursive identities are individual traits that are recognized through discourse with other individuals. Gee's work implicates an examination of students' discourse as they engage in identity work during the science camp program. Sfard and Prusak (2005) viewed identity as narratives and through storytelling, identities are negotiated and constructed. Bamberg and Georgakopoulou (2008) suggested that individuals tell stories of themselves and use narratives to position themselves and display contextualized identities. Paris and Mercer (2002) indicated that narratives might be particularly relevant for identity exploration in informal science settings. They posited that participants in informal learning environments search for meaning to negotiate identities during explorations in these environments. They argued that narratives are fundamental to this process of meaning making in informal settings. As a source of data collection, science camp participants maintained journals during the program. I believed the journals helped engage students in telling their personal stories and provided me with access to their second person identity narratives.

In adopting a view of socially constructed identities, I believed it was fitting to examine identity construction in informal learning environments. Informal learning environments provide multiple opportunities for social interaction during which learners can engage in identity work. Specifically in the science camp context, the program activities prompted discussion during which students engaged in making meaning of science content and negotiated their identities as learners of science.

The social interactions that take place during learning conversations in informal learning environments may be influential in the construction of students' identities as learners of science. The National Research Council (2009), for instance, speculated that individual and group identity might be shaped and reinforced as an outcome of museum learning conversations. Leinhardt, Crowley, and Knutson (2002) stated that conversations both reflect and change a museum visitor's identity. Identities might be shaped as visitors seek personal meanings from museum content that confirm, disconfirm, or extend understandings of their own identities (Paris & Mercer, 2002).

If identity is treated as situational and influenced by the social context, there is reason to believe that identity might be influenced by the novelty of a new context. Fienberg and Leinhardt (2002) described how a new context, such as an informal learning environment, might shape an identity. They theorized that there are social dynamics (e.g., turn taking, topic control, methods of interaction) that have been established by a particular group for the settings in which the group normally interacts. A novel situation might disrupt this balance, necessitating a renegotiation of the group rules. The novelty of an informal learning environment and learning conversations that take place in this context might prompt the development of students' identities as learners of science. As members of the group socially interact and attempt to jointly construct meaning in a novel setting, their identities as learners may be transformed. Through social interactions, the learner has an opportunity to explore a new identity and have that participation recognized (Luehmann, 2009).

Informal science education environments may provide learners with real-world connections and further guide the identity development process. Gallas (1995) commented that school science often makes few connections with the real-world and students are unable to see how the subject fits into their lives. Science becomes viewed as for school and learners may come to see themselves as not good at science or not fitting in the community of science. Gallas speculated that when students are given opportunities to talk science, they see how science fits into their lives and see themselves as identifying with learning science. In informal science education, learners are given multiple opportunities for talk and learning in these settings is often situated in real-life problems and contexts. This unique characteristic of informal learning environments could influence students' identities as learners of science.

I draw on Holland et al.'s (1998) work and consider that power relations can influence an individual's identity. Power, status, privilege and marginalization are all aspects that play a role in how an individual sees herself as a learner of science. Informal science education camps may help to mitigate this power dynamic. Learning conversations in this setting involve peer-peer interactions and more equitable conversations. Connecting with Lemke's (1990) work, he suggested, "We communicate best with people who are already members of our own community: those who have learned to use language in the same ways that we do" (p. x). The absence of a teacher allows the students to use activity structures that are familiar to them and that are more equitable. As learners engage in equitable conversations, they have a safe environment to explore and negotiate new identities.

Informal science education camps are also non-assessed and non-competitive. The teachers and educators in these contexts are not evaluators but rather mentors and role models for the students. The cultural norms of the classroom and resulting procedures and roles are no longer prevalent in the informal science education context. As a result, the teacher exerts less power over the learner. The lack of power and competition creates a safe and supportive environment which I believe influences students' identities as learners of science.

Finally, I believe the informal science education camp provides learners with access to tools and norms of science that may not necessarily be available in the school setting. For example, at the science camp, students have access to oceanographic research equipment such as organism collection nets, research vessels, refractometers, and organisms. Through exposure and use of the authentic tools of science, learners are able to imagine themselves using the equipment of science and possibly see themselves as a scientist or learner of science. The use of these authentic tools in the informal science education camp context may help to shape and facilitate identity development as learners of science.

Chapter Summary

A review of the literature on identity, sociocultural theories of learning and shared learning conversations provided a framework for understanding how students construct identities as learners of science in an informal learning environment. Identity theory, particularly Wenger's (1998) notion of a community of practice, provided a useful lens to understand the ways in which an individual might come to identify as a learner of science. The literature on shared learning conversations provides insight into the ways in which students interact with one another to make meaning of the artifacts and content of the science camp program. During these conversations, students engage in identity work and may come to see themselves as learners of science.

Chapter Three: Methodology

Overview

This study sought to understand the influence of shared learning conversations on students' identities as learners of science. The central research question that guided the investigation was: What is the role of conversation in influencing participants' identity development as learners of science during an informal science education camp? Subquestions related to this inquiry included:

- What is the nature of identity-related talk during learning conversations?
- How does group identity as learners of science evolve during learning conversations?

I used an exploratory, qualitative case study design to gain insight into the research questions, In this chapter, I make a justification argument for my choice of a case study methodological approach, present my data collection and analysis procedures, and discuss issues of trustworthiness and bias in qualitative research

Case Study Justification

In this section, I make explicit my justification for using a qualitative, case study method for the specific focus of this research investigation. Yin (2009) stated that the research methods employed must align with the nature of the research question being investigated. In this study, I used a qualitative approach to gain insight into the central research question. Merriam (2009) suggested that qualitative researchers are interested in understanding how individuals construct meaning in their worlds and what meaning is attributed to their experiences. Because this research sought to gain an understanding of how participants made meaning with regard to their identities as learners of science at a science camp program, I felt a qualitative approach was appropriate. A definition of qualitative research that I have accepted was presented by Denzin and Lincoln (2008):

> Qualitative research is a situated activity that locates the observer in the world. It consists of a set of interpretive, material practices that make the world visible. The practices transform the world. They turn the world into a series of representations, including field notes, interviews, conversations, photographs, recordings, and memos to the self. At this level, qualitative research involves an interpretive, naturalistic approach to the world. This means that qualitative researchers study things in their natural settings, attempting to make sense of, or interpret, phenomena in terms of the meanings people bring to them. (p. 4)

I also found guidance in this area by Merriam (1998; 2009). Merriam (1998) identified five characteristics of qualitative research. First, qualitative researchers are interested in the meanings that people have constructed of their experiences in the world. Qualitative research assumes that meaning is embedded in people's experiences and meaning is interpreted by the perceptions of the investigator. Second, the researcher, rather than survey instruments or questionnaires, is the primary instrument for data collection. In this sense, the researcher is responsive to the context and can adapt data collection and analysis to the circumstances of the context. Given that the researcher is trying to understand the experiences of people, a third characteristic of qualitative research is that it usually involves fieldwork. The researcher must physically attend to the study context to observe behavior in the natural setting. A fourth characteristic is that qualitative researchers typically use an inductive research approach. Qualitative research builds theory in an inductive manner rather than test existing theory deductively. Finally, as a product of an inquiry, qualitative research often seeks to produce rich descriptions using narratives and pictures rather than relying on numerical data for testing a hypothesis.

Other qualitative methodologists who influenced my thinking follow. Creswell (2003) implied that a researcher would use qualitative research methods in investigations that seek to understand a context or setting and the situated meanings that individuals construct in these contexts. Merriam (1998) adds that qualitative inquiry focuses on meaning in context and helps us "understand and explain the meaning of social phenomenon" (p. 5). In this study, I argue that my research question warrants a qualitative approach. I sought to understand how students socially constructed identities as learners of science while participating in an experience at an informal science education camp. I assumed that multiple realities were constructed socially by the participants as they attempted to make meaning from the science camp experience and construct an identity as a learner of science. As the researcher, I hoped to understand the meanings that participants in this setting constructed from the experience. I wanted to gain an emic perspective; that is, I desired to understand the experience from the participants' perspectives (Merriam, 2009). I used a naturalistic approach and observed participants' behavior in the science camp context, relying on myself as the instrument for data collection, rather than on surveys and questionnaires. In doing so, I was able to construct a rich and detailed description of the context using an inductive approach, drawing on the perspectives of the participants as told through their interviews, journals and conversations during the camp activities.

Merriam (1998; 2009) identified a case study as one type of qualitative research. Creswell (2003) identified a case studies as a method in which "the researcher explores in depth a program, an event, an activity, a process or one or more individuals” (p. 15). The case is the object of study, a unit around which there are clear boundaries (Merriam, 1998; 2009). It is a bounded system (Stake, 2008). Stake (1995) indicated that the case could be bound in time or by activity. A case study in an intensive study of this bounded system and the end product is an in-depth account of the phenomena, or “social unit” (Merriam, 1998, p. 27). Stake (2008) argued that a case study is both a method of inquiry and a product of inquiry. That is, the purpose of the case study is to provide a rich, detailed description of the case.

The case study has several distinguishing features: it is particularistic, descriptive, and heuristic (Merriam, 1998; 2009). By particularistic, a feature of the case study is that it focuses on a particular situation, event, experience, or phenomena. The study provides insight into the particularities of the case and what it might represent. The case study is descriptive and the end product is a rich, thick description of the phenomena of study. It can help to describe many variables influencing phenomena and their potential interactions. For example, it can help to illustrate the complexity of a situation and the many factors that contribute to this complexity. Finally, the case study is heuristic, meaning it can highlight a reader’s understanding of phenomena and bring about the discovery of new meaning for the reader. In linking with these features of case study research, the study I present here intends to provide a descriptive account of the particularities of a case of one science camp. In providing rich, thick descriptions of this particular context, I hope to give the reader an understanding of how identity as a learner of science is constructed in a science camp setting. The descriptions I provide intend to explain the experience of identity development as a learner of science as well as extend the meaning of this phenomenon for the reader.

Yin (2006) detailed the advantages of using case study methods, stating that "compared to other methods, the strength of the case study methods is its ability to examine, in-depth, a 'case' within its 'real-life' context" (p. 111). Yin (2006; 2009) posited that a case study method is fitting when investigating an explanatory question such as *how* or *why* something happens. The case study approach allows an in-depth understanding of a particular context and lends itself to investigations in naturalistic settings.

Crane (1994) and Falk and Storksdieck (2005) have both suggested that research in informal learning environments is in its infancy. Schaubel, Beane, Coates, Martin, and Sterling (1996) echoed this notion, arguing that informal contexts are vastly understudied or ignored. Rennie (2007) pointed out that much of the research that does explore informal learning environments focuses on museums as the context of study. Research in other informal learning environments, such as science camp contexts, are lacking.

The research that has been conducted in science camp contexts used survey instruments and questionnaires to document student gains as a result of a science camp experience (Know, Moynihan, & Markowitz, 2003; Helm, 1999; Markowitz, 2004). For example, Gibson and Chase (2002) administered two quantitative surveys, the Science Opinion Survey and the Career Decision-Making Revised Survey, to understand how a science camp program influenced students' attitudes toward science and interest in pursuing a science career. Although such studies provided an overview and initial understanding of student gains, they failed to elucidate how a science camp experience prompted these changes. An in-depth understanding of the science camp context is still needed.

Stake (1995; 2008) suggests that the strength of a qualitative case study approach is its ability to provide a greater understanding of a case by gaining an appreciation of its uniqueness and complexity. Yin (2009) likewise indicated that the purpose of a case study approach is for the research to provide an in-depth description of the phenomena. The purpose of this study was to gain a deeper understanding of how students learn in a science camp setting; thus, a qualitative case study approach was an appropriate method. This study was an exploratory case study that sought to generate rich, thick descriptions of a case of a science camp to generate a more complete understanding of this context.

Case Selection and Description

The proposed study will focus on one program as a case example of a science camp. Stake (1995; 2008) proposed that there are three types of case studies: intrinsic, instrumental, and collective. An intrinsic case study is usually undertaken when one wants to know more about a particular case. In contrast, with an instrumental case study, a case is examined to provide insight into a broader issue or to redraw a generalization. Finally, a third type of study is the collective case study in which multiple cases are study. In this study, I sought to understand the phenomena of identity development as learners of science and felt an instrumental case study was most appropriate. Because few studies have investigated learning in science camp settings, I believed an exploratory approach was necessary. By studying one case rather than a collection, I could gain initial insights in to the science camp setting that were in-depth and descriptive. This would provide a rich, preliminary understanding of this learning environment.

Merriam (1998; 2009) recommended using purposeful sampling strategies when using case study methods of research in order to select a case that is information-rich for an in-depth study. A criterion-based selection strategy is essential in selecting a case that will provide such a study. The criteria I used for selecting a case included: a program that met the essential characteristics of science camps (i.e., a short-term, science intensive program; offered in a novel setting; focused on motivation, attitude, interest and persistence in science; and provided access to the authentic tools of science), was a residential camp, and offered multiple opportunities for conversation. It was important that the program was offered year round (rather than just during the summer) as the study took place during the spring of 2010. A further criterion was that the camp program be marine science focused. Selecting a science camp program in my area of expertise helped me to focus on the nature of the learning conversations of participants rather than working to understand the content being presented. That is, I was familiar enough with the science content that I was easily able to understand what was going on in the science camp learning environment. This background knowledge in marine science also aided in the transcription process as I was able to decipher and understand the science content talk, particularly when the audio was less clear.

The science camp program at the Marine Science Consortium was selected as a case for this study for several reasons. The *Coastal Ecology* field trip program offered at the MSC represents a typical science camp in that it embodies many of the characteristics common to science camp programs. This study represents an exploratory case study due to a lack of research studies in science camp contexts; a typical case is ideal for gaining an initial understanding of what learning in these environments looks like. An earlier pilot study revealed that student participants at the MSC setting engaged in learning conversations and identity-work (Appendix G). Thus, the activities embedded in the MSC's science camp program were an appropriate site to gain insight into the research question. I bounded the case by focusing on the science camp field trip program and specifically the middle school groups attending the program during a three week study period in the spring of 2010.

Informal Science Education Site: The Marine Science Consortium. The MSC is an environmental learning center and field station located in Wallops Island on the Eastern Shore of Virginia. It was initially formed by a consortium of three public state colleges in Pennsylvania and has since expanded to include a total of 14 member colleges and universities. The consortium was started in order to provide field-based education in marine science and coastal ecology to K-12, college-aged, and adult participants (Marine Science Consortium, 2009).

The MSC's mission is to provide multi-disciplinary education and research opportunities through field-based and hands-on science learning. They also have as a goal to encourage and nurture curiosity and excitement about the environment. The consortium uses as its classroom the bays, marshes, beaches, maritime forests, dunes, off-shore waters of the surrounding Eastern Shore of Virginia. The core values the consortium hopes to instill in program participants' include: learning through experience, environmental stewardship, creativity and innovation, diversity, and student and faculty research. The MSC offers educational programs such as college summer courses, opportunities for participation in scientific research, science camps, and field trip programs (Marine Science Consortium, 2009).

Coastal Ecology Science Camp Field Trip Program. One of the education programs offered at the MSC is the *Coastal Ecology* field trip program. As part of this four day program, groups of students visit the consortium with their classroom teachers and stay on campus in student dormitories. Thus, the program is residential in that participants are housed on campus and eat all meals at the campus dining center. Participants engage in a variety of science activities throughout the day as well as leisure activities such as playing games and completing art activities (Marine Science Consortium, 2009).

The MSC field trip program embodies the essential characteristics of a science camp. As Nicholson et al. (1994) identified, science camps are one type of community-based informal science education programs and are “intensive short-term programs, often residential or day camps, with course-like immersion in science and math and a focus on providing participants with the confidence and competence to pursue formal education in science” (p. 118). The *Coastal Ecology* program is residential and offers participants an opportunity to engage in science activities over the four day duration. Each day, participants engage in a full day of science activities designed to mirror the research practices of professional marine scientists, ecologists, and oceanographers. As a goal, the program seeks to foster curiosity and excitement about the natural world among program participants (Marine Science Consortium, 2009). Fields (2007) further added that science camp programs are typically offered in locations such as the wilderness or marine environment. Because the *Coastal Ecology* field trip has the defining features, I classified it as a science camp type of informal science education program.

Prior to the science camp field trip, *Marine Science Consortium* staff provide assistance to classroom teachers in terms of planning aspects of the trip (e.g., arranging housing, securing health forms, recruiting chaperones, scheduling field trip activities) and offer suggestions for fund-raising to cover program fees. In general, the MSC does not provide pre- or post-trip educational activities for classroom teachers. However, classroom teachers can elect to take the organisms collected during the program back to their classrooms for further follow-up (Marine Science Consortium, 2009).

Field-based and hands-on learning activities offered during the *Coastal Ecology* field trip program include lectures, hands-on activities, research cruises, field-based experiences, and laboratory exercises (Table 1). A detailed description of the camp and the science activities can be found in Appendices E and F.

Table 1

Description of science activities during the Coastal Ecology science camp field trip.

Science Camp Activity		**Description**
Research Cruise	Water Quality	The camp participants collected water samples to test for the following data related to water quality: salinity, temperature, pH, and dissolved oxygen. To measure these aspects of water quality, participants used a refractometer, thermometer, pH test kit and oxygen titration kit, respectively.
	Navigation	At the navigation station, the boat captains taught the participants nautical navigation using the triangulation method. The boat captain showed the camp participants how to use a navigation chart, compass and parallel ruler to determine the latitude and longitude of the boat's position.
	Physical Observations	As a means to collect physical oceanographic data, camp participants used a current cross and stopwatch to ascertain the direction and speed of the current. They used a secchi disk to determine the turbidity of the water and a color chart to measure biological productivity.
	Sediment sampling	The research vessels were equipped with a benthic grab and winch which was used to obtain a sediment sample for investigation. Camp participants learned how to deploy and retrieve the sediment sample as well as how to analyze the sample for color, grain size, odor and presence of organisms.
	Biological sampling	Two methods of biological sampling were used during the research cruise: a plankton net and an otter trawl. Both the plankton net and otter trawl were towed through the water for a period of time to collect macro- and micro-organisms.
Organism Lab	Plankton Lab	The plankton lab typically begin with a brief lecture during which MSC instructors provided relevant definitions they believed were essential to understand

		plankton. Following the lecture, participants used water samples collected from the plankton tow to create slides that they viewed under microscopes. They used keys and field guides to identify the plankton in their samples.
	Macro-organism Lab	The macro-organisms also began with a lecture on organism classification and taxonomy. Participants were then asked to use dichotomous keys and field guides to correctly identify the organisms collected and maintained in the labs and aquaria. The camp participants identified organisms such as algae, marine invertebrates and fish.
	Data Analysis	A brief component of the organism lab involved examining the data collected from the research cruise. Each group of participants from the cruise created graphs of their data which they presented to the whole group. MSC instructors then discussed how to analyze the information collected to interpret patterns and trends in the data.
Intertidal Trip	Sensory Observations	As a first activity on the intertidal trip, MSC instructors encouraged participants to sit quietly and use all of their senses to observe the environment. Following these observations, individuals shared their observations with the whole group.
	Zones Lecture	The intertidal trip involved MSC instructors lecturing about the various zones of the intertidal ecosystem as well as pointing out the characteristics, dominant vegetation and organisms in each zone.
	Biological Sampling	Participants engaged in sieving and seining as a means to collect organisms during the intertidal field experience.
Dunes Trip	Dune Formation Lecture	MSC instructors commenced the dune field experience with a lecture on dune formation and the process of longshore drift. They used dunes along the beach that were in different stages of development to illustrate the process they were describing to the participants.
	Organism Collection	Following the dune lecture, participants were encouraged to scour the shore to collect shells and organism skeletons. MSC instructors provided scientific information about the collected artifacts to the camp participants.
Marsh Trip	Marsh Lecture	The marsh field experience began with a lecture about the zonation of the marsh ecosystem. MSC instructors showed camp participants the various zones of the marsh and discussed the prominent features, dominant vegetation and organisms that characterized each zone.
	Data Collection	Participants collected data related to the salinity, pH and density of the water in the zones of the marsh. They also noted flora and fauna in each of the zones

		they explored. As a large group, they compared their findings to other zones of the marsh as well as to other ecosystems they had visited during the trip (e.g., salinity readings from the research cruise).
	"Productivity Plunge"	A highlight of the marsh trip was the "productivity plunge." During the "productivity plunge" MSC instructors and camp participants jumped into the mud holes in the marsh. The participants enjoyed getting dirty and playing in the marsh mud.
Maritime Forest Trip	Lighthouse Hike	For the maritime forest field experience, MSC instructors led campers on a hike to the lighthouse on Assateague island. Along the hike, they provided scientific information about maritime forests and identified trees and organisms they encountered on the hike. The lighthouse hike concluded with an award ceremony during which each camp participant received a certificate of completion from the MSC staff.

Participants

Merriam (1998) suggested that two levels of sampling are often necessary with case study research. First, the case must be selected for study. Unless the research intends to interview, observe or analyze all of the people, activities or documents in the case, then a second level of sampling within the case will need to take place. In this study, I sampled from within the case and selected middle school students as participants. The case participants in the study included students from middle school field trip groups attending the MSC for the *Coastal Ecology* field trip program. In the next section, I describe background information related to the schools that participated in the field trip program as well as a description of the procedures for selecting individual student cases.

Middle School Groups. During the study period, three middle school groups attended the MSC for the *Coastal Ecology* field trip program: Patriot Middle School, Thomas Jefferson Middle School and Brownsville Middle School[1]. The three schools were located in different Mid-Atlantic States and all were public schools for students

[1] Pseudonyms have been used throughout this report for school names for anonymity purposes

in grades 6-8. Patriot and Thomas Jefferson Middle Schools were all located outside of large cities in their respective states; Brownsville Middle School was located in a rural, farming area of the state (personal communication, November 16, 2009). The schools enrolled between 700-1000 students.

Student Participants. The MSC classrooms and laboratories are equipped to support between 15-23 student participants for instruction. Therefore, school groups larger than 23 participants were divided into smaller groups, each with a different MSC educator. Each group used a different laboratory and classroom area for lectures, lab experiences, and hands-on activities. I selected one of these sub-groups from each school for data collection. Student participants with signed parent consent and assent forms were selected and placed in the sub-group for data collection. All students (N=45) in the sub-groups maintained journals and participated in videotaping of learning conversations.

I selected three students for a more detailed case analysis for each of the science camp sessions (total n=9). I believe that three cases per session was a manageable number that allowed me to collect enough information to construct case narratives that were illustrative of participants' construction of identities as learners of science. I followed these students during the videotaped observations and these students participated in focus group interviews. The developing identities as learners of science of these student cases were the focus of my field notes.

I used a purposeful sampling strategy to select student cases. I selected three students from each school group for a more detailed case analysis (total n=9). Creswell (2003) defined purposeful sampling as selecting participants that will "best help the researcher understand the problem and the research question" (p. 185). As the ability to communicate effectively was essential for my analysis of learning conversations, I selected students who were verbally proficient. I contacted the students' classroom teacher prior to the schools arrival at the MSC to request recommendations for student case studies. I requested the teachers recommend students who were verbal and expressive. Table 2 illustrates demographic information for each of the case participants.

Table 2

Demographics of case participants across gender, ethnicity/race, and grade level placements.

Case Participant[2]	School	Gender	Ethnicity/Race	Grade
Hannah	Patriot MS	F	White	8th
Brynn	Patriot MS	F	White	8th
Dale	Patriot MS	M	White	8th
Celeste	Thomas Jefferson MS	F	African American	7th
Jordan	Thomas Jefferson MS	M	White	7th
Emma	Thomas Jefferson MS	F	White	7th
Addison	Brownsville MS	F	White	7th
Gretchen	Brownsville MS	F	White	7th
Everett	Brownsville MS	M	White	7th

As a means of reporting the cases, I used a general template to organize my findings and focus my narrative for each of the case participant. I began each case narrative by introducing the reader to the case participant and providing a description of their initial identity as a learner of science. I wanted to develop, for the reader, an understanding of each case participant's identity as a learner of science and suggest areas of that might be positively developed by the science camp program. I continued

[2] Students', teachers', and educators' names disguised for anonymity purposes.

each narrative by detailing the key insights for each of the participants to highlight my emerging assertions. I supported the key insights and emerging assertions with descriptive details such as quotations from participants and evidence from the field notes and transcripts. I concluded each of the narratives by outlining the notable areas of identity development as a learner of science for case participants. I believed that this organization format for reporting the case narratives helped to focus my analysis.

Data Sources

Nasir (2002) suggested that identity as a learner develops through both individual agency and through social interactions. Thus, data were collected from both perspectives. Students' individual agency in constructing identities as science learners was measured through data from personal journals as well as observations of individual cases. Data collection to examine the social construction of learners' identities included videotaped observations of group conversations and responses during focus group interviews. The focus of the data centered on learning conversations as students participated in the experiential activities inherent in the science camp program. The learner conversation that surfaced during these activities provided a lens into science learner identity development as participants talked with each other, their classroom teachers, the MSC instructors, and the researcher.

Videotape Observations. Videotaped observations were used to document learners' engagement in conversations during the science camp activities. Erickson (2006) acknowledged that social interactions are complex and nuanced. He indicated that videotape data can provide researchers with fine-grained, detailed information to analyze social interactions. Videotapes allowed for moment-to-moment coding to be conducted. Roschelle (2000) added additional advantages of using videotape data: nonverbal means of communication such as gesturing, body posture, and eye gaze can be documented. Videotapes offer the researcher opportunities for greater data-gathering capacities. Both Erickson (2006) and Roschelle (2000) cautioned that although videotape data may seem more neutral than the researcher, it is still a constructed artifact by the researcher. The researcher is choosing to capture a particular phenomenon and is focused on particular interactions.

I videotaped learners' interactions during the science camp activities. For each science camp session, I videotaped participant interactions during the following science activities: the research cruise, the organism lab, the marsh field experience, and the intertidal field experience. I elected not to videotape the science lectures as observations during the pilot study indicated that lectures did not involve participant input and were mainly dominated by MSC educators. The learners had very limited opportunities to talk during lectures and when they did offer input, it was typically to respond to a question posed by the educator (field notes, July & August 2009). One of the field experiences, the dunes trip, took place on a Naval and NASA base. Due to security on the base, videotaping is prohibited. Therefore, I was unable to videotape during this field experience. Instead, I followed the case participants during this trip and maintained copious field notes as the participants engaged with their peers.

An effort was made to videotape each of the three case participants engaged in a learning conversation during the science camp activities. In some instances, all three of the case participants were included in the same peer group. When this happened, I videotaped the group through the entirety of the activity. There were times when the case participants engage in science activities in different groups. In these instances, I videotaped one participant through an episode and then would move to the next case participant. Lemke (1990) indicated that episode changes are marked by a change in the activity type or a change in topic. When the activity or topic changed, I moved on to tape the other case participants.

Focus Group Interviews. Sociocultural theories of learning and shared learning conversations prompt researchers to focus on the group as a unit of analysis. In this study, I was interested in how students' identities as learners of science developed in the social interactions inherent in learning conversations at the science camp. I viewed that focus group interviews were more appropriate for my research question than individual interviews. Bogdan and Biklen (2007) detailed that focus group interviews foster talk among individuals and are fitting when the purpose of the interview is to spark conversation. A focus group interview may prompt participants to formulate and articulate their view.

The case participants selected from each camp session engaged in a focus group interview before and after the science camp program. A pre-camp focus group interview was conducted upon arrival of the school groups at the MSC campus before the participants engaged in any of the science activities. I also engaged the participants in a post-camp focus group interview after the completion of the program's science activities. The focus group interviews were videotaped and audiotaped. The focus interviews were conducted in the MSC laboratory classrooms.

I used a semi-structured format with open-ended questions for the focus group interviews. I constructed questions that served as starting points for a conversation with participants, but was flexible and explored topics that surfaced during the interview. The focus group interview protocol can be found in Appendix A.

Interviews with Classroom Teachers. I conducted individual interviews with the formal classroom teachers as a means to gain their perspectives on students' identities as learners of science. My analysis of students' identities as learners of science was limited by the short-term nature of the science camp program. I believed the classroom teachers could offer insights into students' identities as learners of science as I assumed they have had a longer and more in-depth history with the students. The classroom teachers were interviewed before the science camp program began and then again at the conclusion of the program.

I used a semi-structured format with open-ended questions for the individual interviews with classroom teachers. The classroom teacher interview questions included: How does (student) usually participant in science lessons? Do you think he/she has confidence in their abilities as a science learner? How do you think (student) sees himself/herself as a learner of science? The teacher interview protocol can be found in Appendix B.

Participant Journals. Researchers that study informal learning environments recommend the use of diverse methodologies, such as journaling, to capture participants' experiences in these settings (Ellenbogen et al., 2007; Falk & Dierking, 2000). Olitsky (2007) implemented journaling activities in a study of students' school science identities as a means to gather data on students' lives. Using Olitsky's method of data collection through journaling as an example, I engaged science camp participants in a journaling activity as an additional method of data collection.

The purpose of the journals was to gain access to the learners' perspectives related to their identities as well as prompt participants to reflect on their experiences as part of the science camp field trip program. Information collected from the journaling activity was also used to construct narratives, or portraits of the case participants. The students completed a journal entry each evening, after daily science activities have been completed. The first entry prompted participants to describe their background and personal history as well as detail their prior experiences learning science. Subsequent entries prompted participants to discuss their experiences during daily science activities. The journal prompts can be found in Appendix C.

Researcher Field Notes. Throughout the duration of the study, I observed the science camp program as a participant observer. Angrosino (2008) commented that participant observation is “grounded in the establishment of considerable rapport between the researcher and the host community requiring the long-term immersion of the researcher in the everyday life of that community” (p. 165). Bogdan and Biklen (2007) acknowledged that as a participant observer, the researcher acts as both a participant and an observer. During the pilot study, I lived on the MSC campus with the science camp participants, engaging in the science learning activities as well as the other everyday activities (e.g., eating in the campus dining room, playing games during leisure activities, having ice cream at a local establishment). According to Angrosino’s (2008) definition, in this context, I considered myself a participant observer. In the present study, I was immersed in the context as a participant, although I did not live on campus as I did during the pilot study. However, my rapport with the host community and engagement in learning activities during the program, I believe, qualified me as both a participant and observer.

As a participant observer, I maintained field notes to document what Angrosino (2008) described as focused observations. In focused observations, the researcher observes only information relevant to the research problem and issue at hand. In this regard, I recorded in the field notes only information related to identity work in the context of shared learning conversations. I believed that my documentation of the nature of the science learning activities during the pilot study justifies this choice. By excluding descriptions of the science activities, I was able to focus on the case study participants and the specific ways in which they engage in identity work during the science camp activities.

I used the field notes document data specifically related to aspects of identity work that were generated in context. The field notes further helped me to construct a narrative for each of the case students; that is, to create what Bogdan and Biklen (2007) refer to as "portraits" (p. 211). I also used the field notes to document aspects of identity work in the context of science camp learning activities.

Throughout the course of the research study (data collection and analysis) I also maintained a researcher reflective journal. In the reflective journal, I documented ideas such as my emerging assertions as the study progressed as well as justifications for the data collection decisions. Merriam (1998) contended that in qualitative research, the researcher is the data collection tool and flexibly adapts to the naturalistic setting of the study. By maintaining a reflective journal, I was able to express my thinking for such flexible adaptations that took place during the study period.

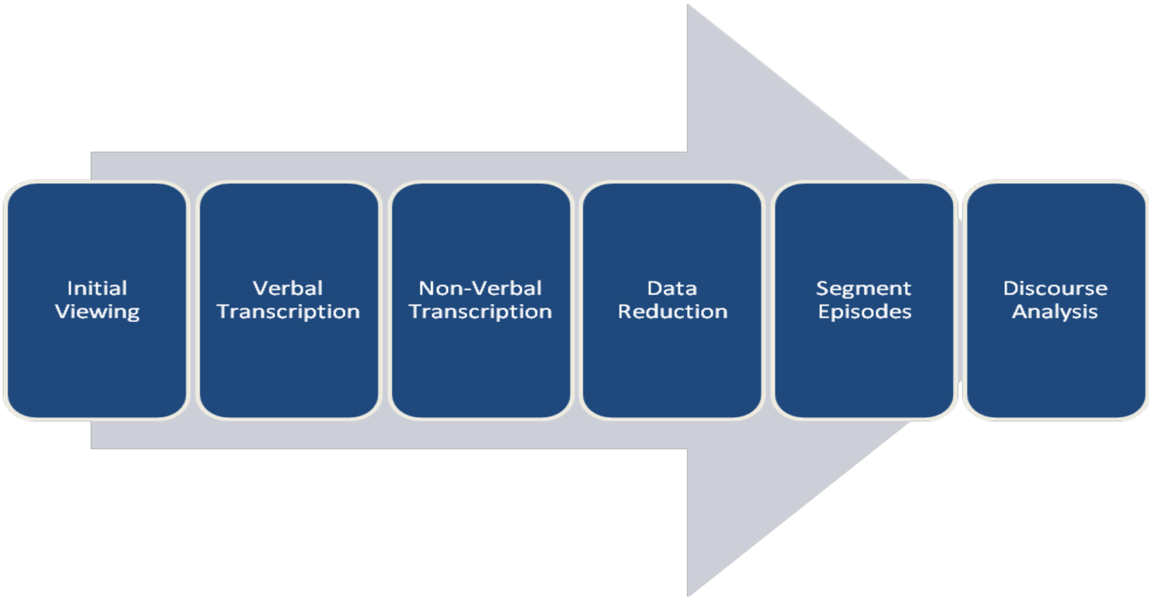
Data Management and Analysis

For this case study, I used Merriam's (1998) position on data management and analysis to examine the collected data. Merriam viewed qualitative case studies as emergent in that working hypotheses and educated guesses guide the researcher's analysis and attention to certain data. The process of data analysis is recursive and dynamic and allows for emerging insights, hunches and tentative hypotheses to direct the next phase of the data collection and analysis. In using Merriam's approach, I will repeatedly review the videotapes and other collected data to find confirming and disconfirming evidence for emerging assertions.

Videotaped Observations. Travers (2009) indicated that more information, such as gestures and interactions, can be noticed by the researcher through videotape analysis. However, Travers cautioned that it was important for the researcher not to shift attention away from understanding the underlying phenomena of study. In this way, Travers argued that the technological use of videos for research is not necessarily innovative if the same methods of analysis are employed. Instead, Travers argued for innovative methods of data collection coupled with innovative methods of analysis such as considering wider social and political relationships. Travers identified methods such as discourse analysis as one analytical innovation. In line with Traver's recommendations, in this study I used videotaping in combination with methods of analysis including discourse analysis and constant comparison methods to gain insight into the research question.

As a means to analyze the videotaped observations, I used a whole-to-part, inductive approach as recommended by Erickson (2006). Wiggins and Potter (2008) suggested a similar approach when analyzing discourse. They recommended an iterative process that involves going back and forth between the recordings and transcripts to develop preliminary codes. Using this approach, my analysis of the videos was a reiterative approach in which I went back and forth between the video data and my emerging theory. Figure 3 provides an overview of the procedures I used for preparing and analyzing the videotapes.

Figure 3. Procedural framework for preparing and analyzing video data.



I began the analysis by reviewing the entire recordings as a while, in real-time without stopping the videos. Roschelle (2000) suggested that relying on transcription too early in the videotape analysis process can be a disadvantage because transcriptions are not as rich as the original video. A first watch of the video provided a preliminary understanding of participants' learning conversations and the nature of their identity talk. While first viewing the videos, I maintained the equivalent of field notes, noting the general nature of participants' interactions as well as the times of transitions between activities.

As a second step, I watched and transcribed the interactions between participants. Gee (2005; 2011) cautioned that transcription is a first step of analysis. The researcher has to make theoretical judgments as to what should be included in the transcription. The transcription is part of the analysis. Gee (2011) suggested that transcripts can range from very detailed or narrow to transcripts that are much less detailed or broad. Judgements of relevance in the transcripts are based on the researcher's theories of how language, situations and interactions work in general and in the specific situation being analyzed.

In my analysis of the collected data for this study, I believed it was important to have more detailed transcriptions. I viewed that in addition to verbal interactions, participants use pauses, gestures, intonation, stress, body language, and facial expressions to further communicate their situated identities. Therefore, I felt it was important to include both the verbal interactions and non-verbal interactions in the transcripts. I first watched the video and noted all the verbal interactions in the transcripts. Then, I watched the tapes again and transcribed all the non-verbal interactions. This included the non-verbal cues that the speaker used as well as those that other members of the group demonstrated as they listened and responded. Through both rounds, I developed transcripts that were detailed. I used Jefferson transcription conventions as notations in the transcripts. The symbols I used for noting interactions in the transcripts are listed in Table 3.

Table 3

Symbols and conventions used in transcripts.

Symbol	**Use**
[text]	Indicates the start and end point of overlapping speech
word= =word	The equal sign shows that there is no discernible pause between two speakers' turns
(·)	A brief pause
∨	Falling pitch or intonation
? or ↑	Rise in pitch or intonation
-	An abrupt halt or interruption in an utterance
ALL CAPS	Increase in volume
Word	Indicates the speaker is emphasizing or stressing the speech
:::	Indicates prolongation of a sound
(hhh)	Audible inhalation or exhalation
(text)	Speech which is unclear or in doubt in the transcript
[??]	Inaudible speech in the transcript
((text))	Annotation of non-verbal activity or noting aspects of the context

Data reduction was the next step in analyzing the videos. Erickson (2006) noted that videotape methods of data collection provide much more potential information to the investigator than can be analyzed. He suggested that data reduction of videotapes is necessary to focus attention on aspects relevant to the research question.

Using previous research on learning conversations as a consideration, I reduced the data by excluding participants' non-relevant talk. This included any talk not related to the content of the science camp activities. For example, in an analysis of videotapes at a museum, Allen (2002) excluded navigation talk, such as a visitor discussing a broken or missing exhibit. As a means to reduce the data, I eliminated talk that was not relevant to the research question such as students speculating about the leisure activities for the evening or attempting to guess the lunch menu in the MSC campus dining room. After I reduced the data, I was left with conversations that focused on science talk as part of the camp learning activities.

I then segmented the tapes into episodes. Lemke (1990) suggested that episode changes are marked by a change in the activity type or a change in topic. He noted, "But there are usually several signals of a boundary between episodes: Students will shift posture, turn the pages of their notebooks, put down their pens, look around the room, comment to another student about something, look out the window, ask a question, and so on. The teacher will pause, or turn to write at the blackboard, or look down at his notes, or admonish student behavior, and then start the new episode with 'O.K.' or 'Now' " (p. 50). I also considered Zimmerman et al. (2009) criteria for segmenting conversations in informal learning environments. Their criteria identify a segment as a series of conversation turns where group members attempt to make sense of an artifact, animal, or phenomenon presented in an exhibit. In the context of the science camp, a segment of talk will include a series of conversation turns that center around topics such as the interpretation of a particular idea presented by an MSC educator or classroom teacher, talk related to identifying an organisms, or attempts to solve a problem. Crowley, Callanan, Jipson et al. (2001) segmented learning conversations into non-overlapping interactions. That is, a non-overlapping interaction is a period in which all members of the initial group are engaged in the conversation. As members leave or new members join, a new conversation segment commences. I used these various criteria for segmenting the videos. For example, when a new learner entered or left the group, I considered that a new segment of the conversation commenced. In some cases, the group began discussing a new topic (e.g., shifted talk about a snail to talk about a worm). This was also considered a new segment of conversation. At other times, the groups transitioned from one activity to another (e.g., a shift from seining to sieving) and this too was considered a new segment of the conversation.

Interviews. All of the focus group interviews were audiotaped and videotaped. I transcribed the focus group interviews using the same notations and transcription conventions discussed above. Paltridge (2006) argued that people use more than just language to display identity during discourse in social situations. He suggested that factors such as the way we dress, the gestures we use, and the ways we act are non-verbal ways in which we represent our identities. As such, I videotaped interviews and transcribed nonverbal interactions that surfaced during the focus group interviews. I noted non-verbal aspects such as participants' gesturing, body language, and eye gaze. All of the interviews with classroom teachers were audiotaped and transcribed for analysis.

Participant Journals. The journals were used to gain insight into participants' backgrounds and prior experiences as well as provide participants an opportunity to reflect on their camp experiences. I primarily used the journal entries to construct narratives for each case participant. The narratives helped to provide a rich description of each case participant and a detailed account of their experience and related identity work as a learner of science during the science camp program.

Field Notes. The field notes were typed into a computer each night at the end of the daily science activities. I used the field notes to enhance the narratives that I created for each participant. The field notes provided needed information about my observations of participants during conversations that emerge as part of the science activities. The field notes were also used as a reflective piece as I reviewed comments related to emerging assertions and methods of analysis.

Data Analysis. Transana, a qualitative data analysis software, was used to manage and organize the data analysis process. Transana is a software program designed specifically for the analysis of video and audio data in education. Using Transana, I was able to identify and code clips as a means of analyzing the data. The software assisted in marking, moving and coding data segments. I developed the themes for the analysis based on the conceptual framework and using methods of discourse analysis and the constant comparative method.

Discourse Analysis. As a means to interpret the video and interview data, I used methods of discourse analysis. Paltridge (2006) defined discourse analysis as a method of analysis that looks for patterns in language across social and cultural contexts. Gee (2005; 2011) described that discourse analysis is examining language in use. Gee and Green (1998) posited that discourse analysis approaches examine ways in which knowledge is socially constructed in educational contexts. Paltridge (2006) identified that researchers have different views regarding discourse analysis. In this study, I adopt a social constructionist view of discourse analysis. I consider that the ways in which we engage in discourse influences our constructed view of the world, of others, and of ourselves (Paltridge, 2006). Gee (2005) indicated that we use language to get recognized as taking on a certain identity. Using methods of discourse analysis, I looked for patterns in participants' speech as they engaged with their peers during the course of the science camp program. An analysis of participants' talk, with a particular focus on the use of language to enact identity, provided insight into the research question.

For this study of middle school learners' identities as learners of science, I felt it was most appropriate to draw on the methods of discourse analysis outlined by Gee (2005; 2011). Gee's (2005; 2011) work specifically addressed how discourse is used to enact identity in certain contexts. Gee (2005) identified seven building tasks of language, one of which included the use of language for building identities. Gee theorized that we build language and activities not just through spoken language but by also using the various symbols, tools, objects to talk, act and interact in a certain way to get recognized as having a certain identity. Gee (2005) refers to this as Big D Discourses and writes, "I use the term 'Discourse,' with a capital 'D,' for ways of combining and integrating language, actions, interactions, ways of thinking, believing, valuing, and using various symbols, tools, and objects to enact a particular sort of socially recognizable identity" (p. 21). In drawing on this notion of language to enact an identity, Gee recommends asking the following question of language: "*What identity or identities is this piece of language being used to enact (i.e., get others to recognize as operative)*" (p. 11).

In a later piece, Gee (2011) provided a toolkit for conducting discourse analysis. By tools, Gee refers to specific questions to ask of the data that examine what speakers or writers mean, intend or seek to do and accomplish in the world by the way that they use language. Application of these tools will help the analyst pay attention to the details of language to make meaning in a given context.

Gee (2011) cautioned that there is no one theory that is universally right or applicable. He argued that certain tools work better for some types of data than they do for others. Therefore, I felt it was important to flexibly apply his model for discourse analysis. That is, I drew on his methods as a template and used the tools I felt were most appropriate for analyzing discursive identities. This meant that I did not rigidly follow Gee's methods of analysis in a step-by-step manner. I began by reviewing the tools and selecting the tools that I felt were closely aligned with the research questions and theoretical framework of the study. In table 4, I list the tools that were taken from Gee's toolkit and applied to the analysis of the data.

Table 4

Discourse analysis tools (Gee, 2011).

Discourse Analysis Tool
The Fill in Tool "For any communication, ask: Based on what was said and the context in which it was said, what needs to be filled in here to achieve clarity? What is not being said overtly, but is still assumed to be known or inferable? What knowledge, assumptions, and inferences do listeners have to bring to bear in order for this communication to be clear and understandable and received in the way the speaker intended it" (Gee, 2011, p. 195)? **The Making Strange Tool** "For any communication, try to act as if you are an 'outsider.' Ask yourself: What would someone (perhaps even a Martian) find strange here (unclear, confusing, worth questioning) if that person did not share the knowledge and assumptions and make the inferences that render the communication so natural and taken-for-granted by insiders" (Gee, 2011, p. 195)?
The Activities Building Tool "For any communication ask what activity (practice) or activities (practices) this

communication is building or enacting. What activity or activities is this communication seeking to get others to recognize as being accomplished? Ask also what social groups, institutions, or cultures support or set norms for whatever activities are being built or enacted" (Gee, 2011, p. 198).
The Identities Building Tool "For any communication, ask what socially recognizable identity or identities the speaker is trying to enact or to get others to recognize. Ask also how the speaker's language treats other people's identities, what sorts of identities the speaker recognizes for others in relationship to his or her own. Ask, too, how the speaker is positioning others, what identities the speaker is 'inviting' them to take up" (Gee, 2011, p. 199).
The Relationships Building Tool "For any communication, ask how words and various grammatical devices are being used to build and sustain or change relationships of various sorts among the speaker, other people, social groups, cultures, and/or institutions" (Gee, 2011, p. 199).
The Sign Systems and Knowledge Building Tool "For any communication, ask how the words and grammar being used privilege or de-privilege specific sign systems (e.g., Spanish vs. English, technical language vs. everyday language, words vs. images, words vs. equations, etc.) or different ways of knowing and believing, or claims to knowledge and belief (Gee, 2011, p. 200).
The Situated Meaning Tool "For any communication, ask of words and phrases what situated meanings they have. That is, what specific meanings do listeners have to attribute to these words and phrases given the context and how the context is construed" (Gee, 2011, p. 200)?
The Social Languages Tool "For any communication, ask how it uses words and grammatical structures (types of phrases, clauses, and sentences) to signal and enact a given social language. The communication may mix two or more social languages or switch between two or more. In turn, a social language may be composed of words or phrases from more than one language (e.g., it may mix English and Spanish)" (Gee, 2011, p. 200).
The Figured Worlds Tool "For any communication, ask what typical stories or figured worlds the words and phrases of the communication are assuming and inviting learners to assume. What participants, activities, ways of interacting, forms of language, people, objects, environments, and institutions, as well as values, are in these figured worlds" (Gee, 2011, p. 201)?
The Big "D" Discourse Tool "For any communication, ask how the person is using language, as well as ways of acting, interacting, believing, valuing, dressing, and using various objects, tools, and technologies in certain sorts of environments to enact a specific socially recognizable identity and engage in one or more socially recognizable activities. Even if all you have for data is language, ask what Discourse is this language part of, that is, what kind of person (what identity) is this speaker or writer seeking to enact or be recognized as. What sorts of actions, interactions, values, beliefs, and objects tools, technologies, and environments are associated with this sort of language within a particular Discourse" (Gee, 2011, p. 201)?

The use of these tools helped me to identify patterns in participants' talk. Coulthard (1977) suggested that the unit of analysis for discourse analysis is the utterance. Using the Transana analysis software, I created analytical clips of the conversation, or an utterance. Zimmerman et al. (2009) defined an utterance as “a chain of spoken language that is a turn of speech by a speaker, akin to a sentence in written language” (p. 7). However, Zimmerman et al. clarify that an utterance does not necessarily have to be a complete sentence. I grouped similar comments under thematic constructs to gain insight into the ways that participants’ identities as learners of science developed during the course of the study. I explain the iterative process for developing thematic constructs from the data in the next section.

Constant Comparison Analysis. I used a constant comparison analysis to determine themes in the data (Charmaz & Henwood, 2008; Huberman & Miles, 1994; Merriam, 1998; Strauss & Corbin, 1998). That is, data were analyzed within and across sources for emergent themes in reiterative phases. First, I used the discourse analysis tools and went through the data chronologically to code for emergent themes. In this iteration of reviewing the data, I used open coding to code utterances line by line for emergent themes. Charmaz and Henwood (2008) recommended line by line analysis for interview data because it prompts th researcher to “look at bits of data anew, dissect them, and label them” (p. 242). I used open-coding procedures and the themes emerged from the data. Codes that emerged from each transcripts and each source of data were compared and similar factors were combined. As initial themes emerged, they were checked against the research questions and theoretical framework of the study. If there was congruence, the themes were named as a tentative category.

Next, the resulting tentative categories were compared to all transcripts and further refined. By comparing within the same set of data and between the remaining data, comparisons were constantly being made and the codes reduced until an emerging theory developed. Tentative categories are tested against the data and emerging theory. The analysis cycled through iterations of reduction of codes until the initial categories were reduced and aggregated. Merriam (1998) indicated that the emergent theory can be evaluated in terms of its explanatory power, how well integrated the elements are and by whether there is logical consistency to the theory. I used memoing to facilitate the recursive process of the constant comparative method. I used the memoing to note my ideas about the codes and to tie together different pieces of data into a developing theory. Charmaz and Henwood (2008) posited that memo writing guides the researcher in the process reducing codes to significant categories that are then explored and checked against the data. The developed categories were used in constructing the case narratives as well as to write about the general themes that were noted across the different cases and school groups. I further used selective coding to select exemplar quotes for reporting purposes in the case narratives. Table 5 summarizes the data collection and analysis methods I will implement in the study.

Table 5

Corpus of data and analysis methods

Event/Participants	*Data Collection Method*	*Analysis*
Observations of conversations during science camp activities	Videotape Researcher Field Notes	Transcription for verbal and nonverbal interactions Discourse Analysis
Focus group interviews with middle school program participants	Audiotape Videotape	Transcription for verbal and nonverbal interactions Discourse Analysis
Individual interviews with classroom teachers	Audiotape	Transcription for verbal interactions Discourse Analysis
Middle school program participants reflections on program	Student Reflective Journal Entries	Selective coding used to construct narratives, or thick-descriptions of case participants

Data Storage and Confidentiality

Wiles, Charles, Crow and Heath (2006) suggested that researchers in social sciences face ethical issues such as a commitment to study participants' rights, a commitment to participants' privacy and a commitment to respect for participants. The researcher must make ethical decisions, such as protecting confidentiality, based on their own ethical and moral views. In the next section, I discuss the ethical considerations of this study, particularly in terms of confidentiality and protecting study participants' privacy by detailing who will have access to the data and how the data were used.

Confidentiality. All of the information collected in this study was confidential to the extent permitted by law. Students and staff members' identities were disguised through the use of pseudonyms in all written materials. Videotapes, Audiotapes, transcripts, journals, field notes and artifacts collected during the program remained private and were not made publicly available. Information was not recorded in such a manner that subjects can be identified, directly or through identifiers linked to subjects. The interviews were conducted with participants in a private area away from others.

This research project involved making videotapes and audiotapes of science camp activities and participant interviews. Videotapes and audiotapes were necessary for the researcher in order to present the participants' voices authentically. The videotape and audiotape data were transcribed for analysis. Only the researcher had access to the video and audio files. Video and audio files were stored on my computer and will be destroyed at the end of ten years.

All data collected during the course of the research was stored by code number at my home and kept in a secure cabinet. Electronic copies of data were stored on the researcher's computer. Only the researchers have access to the data, both hard copies and electronic.

Informed Consent. Parent consent forms and student assent forms were distributed prior to coming to camp, as most of the students attended the field trip program without their parents. Information provided to the subjects was disclosed in a letter to parents, the student assent form, and the parent consent forms. The letter to parents, consent, and assent forms were sent to classroom teachers for distribution to parents and students. The Marine Science Consortium mails essential paperwork (e.g., waivers, emergency contact forms) to teachers prior to the camp program. Teachers distribute the paperwork and collect to bring with them to the field trip program. The letter to parents, consent, and assent forms for the study was mailed with this camp paperwork. The study forms were sent to teachers no later than 2 weeks prior to the field trip program start date. Parents and students had approximately 2 weeks to read through and complete all Marine Science Consortium program related forms for program participation as well as research related information (letter to parents, consent and assent forms). During this time, parents and students had time in their private homes to examine the consent and assent forms.

Consent forms for teachers, parent chaperones, and science camp instructors were distributed and collected 2 hours prior to beginning the research study. Information provided to the subjects was disclosed on the teacher, parent chaperone, and instructor consent forms (please see Appendix H). Consent forms were distributed during the check-in and orientation procedures that the Marine Science Consortium holds for each session before their program begins. Teachers, parent chaperones, and science camp instructors had approximately 2 hours during this time to read through and complete all Marine Science Consortium program related forms for program participation as well as research related information (consent forms). During this time, participants had time to examine the consent. All participants were encouraged to ask questions after reviewing the consent forms.

It was not necessary to obtain informed consent in a language other than English as participants in this study were speakers of English. None of the information was deceptive. Signed assent and consent forms were stored in my home. Participants were informed that they may withdraw from the study at any time without penalty.

Trusthworthiness, Reliability, and Bias

The issue of validity has been contested by researchers in qualitative education. Researchers such as Wolcott (1990) reject the notion of validity, suggesting that to ask about validity in qualitative research is to ask the wrong question. The term validity, Wolcott asserts, is rooted in an epistemology that views research as a means to represent the world as it really is. Knowledge, in this epistemological tradition, is represented through measurement and tests. Grumet (1990) adopts a similar stance, stating that validity through a detached objectivity is unfeasible; the researcher cannot detach from the study but is instead a part of the study. Thus, she rejects a scientific standard of validity.

Merriam (1998) viewed that issues of validity and reliability should be considered from the philosophical position of the research paradigm. Within the paradigm of qualitative research, the concept and standards for validity may be inappropriate. Instead, quality and trustworthiness of the data may be more appropriate criteria. I used the following strategies to address issues of trustworthiness: crystallization of data, a member check procedure, checking rival explanations, maintaining a chain of evidence, and addressing researcher bias.

Crystallization of Data. I will use crystallization of data as one method to promote trustworthiness of the research. Richardson and St. Pierre (2005) described how crystallization differs from triangulation. They write,

> I propose that the central imaginary for 'validity' for postmodernist texts is not the triangle—a rigid, fixed, two-dimensional object. Rather, the central imaginary is the crystal, which combines symmetry and substance with an infinite variety of shapes, substances, transmutations, multidimensionalities, and angles of approach. Crystals grow, change, and are altered, but they are not amorphous. Crystals are prisms that reflect externalities and refract within themselves, creating different colors, patterns, and arrays casting off in different directions. What we see depends on our angle of repose— not triangulation but rather crystallization. (p. 963).

Using this metaphor, crystallization suggests that the researcher attempts to understand the many facets and layers of the problem. Given this metaphor, the notion of triangulation is no longer sufficient. Instead of seeking insight from three sources to triangulate, crystallization recommends that the researcher collect data from a variety of sources *and* from different perspectives.

As a means to address issues of trustworthiness, I used crystallization of data to include multiple perspectives including those of the teachers, students, and myself (Charmaz, 2000). Merriam (1998) suggested that methods of crystallization enhance trustworthiness of the research through pooled judgment related to emerging theories. Crystallization of data incorporated multiple perspectives including the researcher's perspective as well as the perspective of the students and classroom teachers. I used multiple sources of data including researcher field notes, videotaped observations, students' reflective journals, and focus group interviews.

Member check Procedure. Another method for addressing the trustworthiness of a study is to implement a member check strategy (Stake, 1995). A member check provides research participants an opportunity to check for accuracy and appropriateness in representing their voices and actions in the writing (Stake, 1995).

I employed a member check procedure by requesting participants' feedback related to tentative interpretations. I requested staff at the MSC to read drafts to check for appropriateness and accuracy in the way that I portrayed their organization and the *Coastal Ecology* field trip program. A member of the leadership team (the program manager) as well as an educator at the MSC both read drafts of the write-up. Both the program manager and the educator completed the task and offered no rival explanations. The program manager commented that she thought the descriptions looked good. The educator raised concerns about the descriptions with regard to changes made at the MSC campus since the study period. Specifically, the labs have been torn down and all of the classes and lab experiences take place in a new building. However, because these changes did not take place during the course of the study, my description represents the state of affairs as they were at the MSC when I conducted the research.

A sample of middle school participants were also invited to review preliminary case narratives. I sent sections of the narratives to study participants via email. I asked the participants to review the narratives and provide their feedback and reactions to my interpretations. Participants were encouraged to point out areas where they would add, delete or change my interpretations as written in the narratives. The participants that responded to the member check did not offer any rival interpretations and commented simply that I portrayed them accurately. For example, in response to the member check inquiry, Hannah responded, “After reading, there is nothing I would delete, or add! I think you described exactly how I felt about science before and after the camp experience. This experienced really changed my perspective of the science field and my friends and I still talk about it to this day” (member check procedure, April 2011).

Checking Rival Explanations. As my theory emerged in the course of the study, I sought to promote trustworthiness by checking rival explanations. Yin (2009) and Merriam (1998) recommended checking rival explanations as a means to evaluate a case study analysis. Alternative explanations were considered in relation to the evidence and theoretical framework and adopted or discarded. For example, Yin (2009) recommended such rival explanation checks as considering researcher bias and checking rival theories that differ from the original theory but that might explain the results better. I engaged in these types of rival explanation checks to promote the trustworthiness of my analysis. I engaged in peer debriefings of emergent findings to gain feedback and test explanations (Merriam, 1998).

Maintaining a Chain of Evidence. Yin (2009) recommended maintaining a chain of evidence to increase the reliability of case study research. In a parallel fashion, Merriam (1998) suggested maintaining an audit trail. Both concepts have in common the maintenance of a detailed account of the study’s developmental trajectory, from the conceptualization of the study to the eventual study conclusions. The researcher must provide a detailed description of how the data were collected and analyzed in such a way that an external “auditor” (Merriam, 1998) or “observer” (Yin, 2009) can trace the researcher’s steps in conducting the study. In this report, I provide a detailed account of how the data were collected and how the findings were derived.

Researcher Bias. Trustworthiness is also established by stating the researcher's biases upfront. Merriam (1998) suggested clarifying the researcher's positionality as well as the underlying assumptions guiding the research investigation. In the problem statement earlier in this report, I explained my positionality and how my prior experiences have influenced various aspects of the study. I described the assumptions underlying the study as well as the theoretical orientation that guided the study.

Issues of Generalizability

Eisner and Peshkin (1990) defined that generalizations, "consist of ideas ─ or images ─ that in some way allow us to understand or anticipate phenomena we have not yet encountered from phenomena we have encountered. Generalizations enable us to form expectations on the basis of prior experience" (p. 171). The notion of generalizations seeks to use research findings to inform new situations and experiences. Historically, case study research has been criticized for its lack of generalizability. Stake (1995) suggested that the case is often perceived as a poor basis for generalization. Donmeyer (1990) stated that historically, generalizability has been framed within quantitative research. The procedures for generalization are well-defined through random selection from a population and by controlling variables. Donmeyer argued that these procedures are not relevant for qualitative research. Eisner and Peshkin (1990) pointed out that case studies rarely use random selection and usually have too small a sample size for tradition definitions of generalization. Donmeyer (1990) and Schofield (1990) argued that traditional notions of generalization are not appropriate for qualitative research and call for new conceptions of generalization for more contemporary forms of research such as qualitative approaches. Their writings explored generalization within the context of qualitative research.

Donmeyer's (1990) view of generalization within the context of qualitative research argued for a broader view of generalization. Donmeyer distinguished between two types of generalizations: formal generalizations and naturalistic generalizations. Formal generalizations are produced through quantitative research designs and the use of inferential statistics. On the other hand, naturalistic generalizations are developed through personal experience. Generalization surfaces as the reader finds personal connections in the narrative. The case narrative provides a vicarious experience for the reader, one that can aid the reader in their interpretation of a phenomena.

Schofield (1990) takes a different perspective on the notion of generalization in qualitative research. Although she too argued that new ways of thinking about generalization are needed for qualitative research, she takes a different approach than Donmeyer (1990). In Shofield's (1990) view, generalization through qualitative research should focus on the following questions: what is, what may be, and what could be. Schofield provided techniques for designing research to address these questions of generalizability.

With specific regard to the generalizability of case study research, several methodologists have offered their ideas. According to Yin (2009) case study methodology supports analytic generalization. That is, the findings of case study research can be generalized back to a developing theory in a manner that expands, challenges, supports or refutes the theory. Stake 1995 also addressed the notion of generalizability in case study research. Stake provided two characterizations of generalizations: petite generalizations and grand generalizations. Generalizations that occurred within the case or across a few cases were identified as petite generalizations. For example, in the case of a child, a child might repeatedly face a certain difficulty with respect to learning. This is a form of generalization that Stake regards as a petite generalization. A grand generalization, on the other hand, is using case findings to modify an existing generalization or theory. This links with Yin's (2009) reference to analytic generalization. In both cases, findings from case research are generalized back to a developing theory.

Merriam (1998) describes a different approach to generalization, one that parallels the ideas of Donmeyer (1990). Merriam (1998) postulates that readers bring to a case study their own experience and understanding which lead to generalizations as they add the new data to their previous ideas. Generalization, in this regard, refers to the reader participating in extending generalizations using their previous experiences and understandings and linking them with the new finding expressed in the case description.

In this study, I hoped to attain some level of generalization. However, I wish to emphasize that the power of the case is in its particularization rather than its generalities (Stake, 1995; 2000). That is, in providing rich, thick descriptions of the context, I hope to highlight the particularities of the science camp context in a manner that helped to add detail and extend the theories of identity in informal science education environments. In this regard, I too believe that new conceptions of generalizability that are appropriate for qualitative research paradigms are necessary. Yin's (2009) concept of analytical generalizations and Stake's (1995) concept of grand generalizations seem most appropriate for this current study. The research findings I report here attempt to add new data to previous ideas regarding identity and learning conversations in informal science education environment. I believe my findings expand, challenge, support and refute theories in these areas. I further believe that petite generalizations are necessary to demonstrate the common themes that emerged across the data provide by study participants (Stake, 1995). These petite generalizations helped me to illustrate the main findings of the study and build theory.

Chapter Summary

In this chapter, I listed the research questions guiding this investigation. I justified the use of a qualitative case study methodology for gaining insight in the research questions. I described my methods for the case selection and sampling of participants as well as described the study context, the *Coastal Ecology* science camp field trip program at the MSC. I identified my sources of data and the ways in which I managed and analyzed the collected data to develop a theory. In the next chapter, I discuss the findings of these analyses.

Chapter Four: Findings

Introduction

The purpose of this chapter is to provide a rich sketch of participants' experiences at the informal science education camp as a way to gain insight into ways that engagement in learning conversations shaped their identities as learners of science. In the first section, I provide case narratives for six of the study participants. The case narratives highlight the unique ways in which language use during learning conversations influenced identity development as a learner of science. The second section describes the prominent themes that emerged from my careful inspection and analysis of the data across all of the case participants. Finally, I discuss how the group identity as learners of science was influenced by the informal science education camp.

Brynn: "Eww, it's squishy!"

Brynn was a white female that attended the science camp field trip program at the MSC as an 8th grader from Patriot Middle School. Brynn was a petite, yet energetic girl with dark, wavy hair. She wore glasses much of the time which gave her a studious look that contrasted with her animated personality. Over the course of the camp program, Brynn could be found giggling and joking with her peers. She seemed to have a special talent for finding the fun in activities which was expressed in her constant smile, laughter and positive attitude. Brynn's classroom science teacher, Mr. Malone, was a white male that taught 8th grade science at Patriot Middle School. Mr. Malone talked excitedly about her, commenting that Brynn had a bubbly personality and he viewed her as a fun student to have in his classroom. He elaborated, "she is so animated" and "lively…very talkative" (pre-camp teacher interview, May 2010). Later, he continued, "she's a fun kid" and "she's a joy to be around." He offered the following description of Brynn, "she's probably the kid that when she was a baby sang herself to sleep when she was younger" (pre-camp teacher interview, May 2010). His comment sought to exemplify that Brynn was a free-spirit, happy and playful.

Brynn began the science camp program as a learner who identified with science to some extent. For Brynn, there seemed to be some tension between being an adolescent and being what she referred to as a "science person" (pre-camp focus interview, May 2010). Brynn noted, "science isn't my life. Like, it's something I like and I could go into doing but, it's not really my life, so, I don't think they'll, they see me growing up to be a scientist" (pre-camp focus interview, May 2010). For Brynn, her identity as a learner of science was to a degree framed by how integrated science was in her life. She believed science was not her whole life and that she had other interests which influenced how she identified as a learner of science. Brynn stated that she did not believe others would see her as becoming a scientist and in her interview she commented that she did not see herself as a "science type of person" (post-camp focus interview, May 2010).

Before the science camp program, Brynn had some initial interest in science. Brynn stated that she liked science and was particularly interested in Earth science topics such as oceanography. In her pre-camp journal, Brynn reflected and wrote, "I like the type of science that I will use and apply to everyday things" (Day 1 journal entry, May 2010). In Brynn's view, the Earth sciences had more real-life connections which for her made it a topic of interest. Brynn stated,

> I, umm, actually like the Earth science cause it's more like I think of I'll use it more, like, we learned about cell, atoms and everything that's good to know, but I wanted to really focus on stuff that I would want to know or like actually like want to use or have to use. (pre-camp focus interview, May 2010).

Brynn was excited for the science camp because, as she mentioned, Earth science was an area of science that she enjoyed. The oceanography focus at the camp was an area of science that Brynn enjoyed. She stated that she hoped to learn about the ocean valley, tides, and waves while at the camp as well as more about marine life (pre-camp focus interview, May 2010).

Although Brynn expressed that she identified as a learner of science with regard to her interest in science, her classroom science teacher, Mr. Malone, provided a more nuanced view of this aspect of her identity. Mr. Malone suggested that Brynn may have some preliminary interest in science but felt that she was more interested in other academic areas. He commented,

> I don't think science is her general area. However, she did sign up for this trip and wanted to be part of this, and really wanted to go, because, you know, she does have an interest in it. But, I don't think it's her *main* interest. (pre-camp teacher interview, May 2010)

Later in the interview, he continued this idea,

> She's a kid that, I think that, she's open to the world, but it's not her particular area of expertise that she feels she wants to expand upon or grow with throughout the years. She may have some other interests, more artistically inclined, things like that. (pre-camp teacher interview).

Mr. Malone's statements seemed to indicate that Brynn had some interest in science but that she may have greater interest in other areas.

Mr. Malone further speculated that Brynn's interest in science may be in terms of the fun she believed she would have in the process. That is, he was uncertain whether she was interested in science with regard to the content or in terms of having fun during the process. He stated, "she sees herself, just enjoying the process, if she can" (pre-camp teacher interview, May 2010). He imitated what Brynn might say and commented, "Is there any way I can enjoy this" (pre-camp teacher interview, May 2010). Mr. Malone believed that coming on the trip was a way for Brynn to enjoy science. Although he was uncertain of Brynn's true interest in science, he felt that it was an area of her identity as a learner of science who was developing. The field trip to the MSC was part of a science club program and Brynn had expressed enough interest in science to sign up for the club and field trip. Mr. Malone commented,

> …this year she's opening up a little bit more and trying to be more of a better learner of science just by the fact that she joined the club and wanted to be on the trip. And it may have been just for fun, and that may have enticed her, something, something new to be a part of this and sounds really cool. She likes the idea of the oceans and things like that. But I don't think she gets the idea of the science part of it. It's just, "↑wow, the ↑ocean, you know, I'm going to learn about the ocean, you know, I'm going to learn about *oceanography*.

Although Mr. Malone questioned Brynn's true interest in learning science, he saw that it was an area which he believed was emerging. He was uncertain whether or not Brynn was coming on the trip to expand her knowledge or just as an opportunity to have fun with her friends but saw that it was an area in which she was improving.

Brynn began the camp program as a learner who was somewhat tentative about participating in science and unconfident in her capabilities as a science learner. Brynn described, "Science in not my overall strength but it definitely is something I like" (Day 1 journal entry, May 2010). Her journal entry demonstrated that she enjoyed science, but did not perceive science as her best school subject. During the pre-camp interview, Brynn suggested that she did not view science as her overall strength because her memorization skills were not strong. Brynn commented, "I'm good at certain parts of science but unlike Dale I'm not really good at the whole memorization" (pre-camp focus interview, May 2010). In Brynn's view, science involved memorization, a skill she felt she lacked. This perceived weakness resulted in Brynn's lack of confidence in her abilities as a learner of science.

During the pre-camp interview, Mr. Malone talked in detail about Brynn's lack of confidence in her abilities as a learner of science. He believed this was evidenced in her lack of participation in class, her failure to take leadership roles, her hesitation when responding to science questions, and her lack of assertiveness. When asked how he thinks Brynn would see herself as a learner of science, Mr. Malone seemed to suggest that she would be concerned about how hard it would be for her to learn science (pre-camp teacher interview, May 2010). He suggested that Brynn was tentative about science and often hesistant to answer questions and participate in conversations in the classroom. He stated, "she likes to participate because she just likes to be part of what's going on. But, a lot of times she's very scared because she doesn't think she's as good with the sciences, or knows it as well" (pre-camp teacher interview, May 2010). This lack of confidence, in the teacher's view, resulted in Brynn not fully engaging in the science lessons in the classroom. Instead, the teacher believed Brynn was just "going through the motions because she has to in the sciences" (pre-camp teacher interview, May 2010). He believed her reluctance to participate in the science classroom stemmed from her belief that science could be difficult and her uncertainty regarding her abilities as a learner of science. He imitated how Brynn might talk about herself and commented, "I can learn this but, it could be really hard. I'm not sure…I'm not sure I want to do it. I'm not sure I can" (pre-camp teacher interview, May 2010). By imitating how Brynn might talk, Mr. Malone was demonstrating Brynn's lack of confidence toward science learning. He added,

> She’s not very assertive with her answers, she’s not been very assertive at taking charge of a project, because she’s not quite confident with herself, I think, as a science learner to be able to, jump in, in front of these three other people and say, ‘this is how you do it,’ or ‘this is the way we should do it’…[Brynn would say] ‘I’m not quite sure. What do you think?’ You know, like ‘I’m a little bit uncertain’ (pre-camp teacher interview).

Mr. Malone’s comments indicated that Brynn did not identify as a learner of science which he believed resulted in her limited participation in the science classroom

I also noticed Brynn’s lack of confidence during the pre-camp focus interview and during the early learning activities of the science camp. During the pre-camp focus interview, Brynn was very hesitant to speak and did not participate as often as the other participants in answering questions. When she did answer, she spoke softly and quietly (pre-camp focus interview, May 2010). At the beginning of the science camp, she appeared to get frustrated easily and when this happened, she would quickly turn the task over to another group member. For example, during the research cruise, which took place on the first day, Brynn was attempting to read the salinity and density from the refractometer. As the participants read the refractometer, they often had a difficult time figuring out what scale to read in the viewfinder as well as difficulty in determining where the line was for the reading. Brynn experienced this difficulty and struggled to find the line for the salinity reading. She also had some confusion about which scale to read. After working for a time to determine the salinity, she ended up frustrated and handed it over to her group member to read for her (Research cruise field notes, May 2010). Similarly, during the organism lab on the first day, Brynn was reading through a field guide attempting to determine the correct identification of an organism. Her body language and comments indicated that she was frustrated. She stated, "*I DON'T KNOW*" and slumped in her chair, holding her chin in her hands (Organism lab field notes, May 2010).

Brynn's initial frustrations may have stemmed from her lack of confidence. Because she did not see herself as a learner of science, she questioned her abilities while in the midst of the activities. Her lack of confidence hindered her persistence when she faced a challenging science learning task. From Mr. Malone's comments, Brynn's comments, and field notes, there was evidence to suggest that before the science camp, confidence was an area that was lacking with regard to Brynn's identity as a learner of science.

In Brynn's case, conversation played an interesting role in her identity development as a learner of science during the course of the camp program. Brynn seemed more comfortable to engage in science learning conversations as a result of the relaxed atmosphere of the informal science education camp setting. Brynn pointed out this aspect and described that the science camp experience "opened her up a little bit" and made her feel more comfortable asking questions of her peers (post-camp focus interview, May 2010). I observed Brynn engaging in science learning conversations through the use of everyday language and language structures with which she was familiar. By everyday language, I refer to non-technical language that the participants might use in their everyday lives. I used Lemke's (1990) notion of everyday activity structures and consider that some activity structures are special or technical while others are more aligned with everyday practices. Lemke suggested that a lab report or the use of triadic dialogue might be a special form of structuring language while writing a letter or talking on the phone might be everyday structures.

For example, during the organism lab, she used terminology such as "squishy" to characterize an organism with which her group was working. She stated, "Eww, it's squishy. It’s squishy” to describe an organism known as a boring sponge (Organism lab field notes, May 2010). Although the term “squishy” is not necessarily one that would be considered scientific, it appropriately identified a characteristic of this organism. As the conversation between Brynn and her partner developed, they recognized that “squishy” only identified one aspect of the organism. Later in the conversation they continued,

> Brynn: It’s squishy, but we were feeling the hard part when we touched it and it closed so we didn’t know it was soft on the outside
>
> Regan: ((touches the organism to investigate Brynn’s comment)).
>
> Brynn: So, it is actually soft and it has, like, a…like a hard rail ((shrugs)).

Although the content of Brynn and her partner Regan’s conversation might not be labeled as science discourse, they are describing features of the organism that helped them to correctly identify the organism. They realized two aspects of what they were observing, a hard shell as well as a part of the specimen that was “squishy,” and “soft.” Through this recognition of “hard” and “soft” parts they determined that the specimen they were looking at was a shell that was covered in a boring sponge. Through use of everyday language that was familiar to Brynn and Regan, they were able to engage in a learning conversation that resulted in an appropriate outcome. The relaxed atmosphere of the informal science education camp and the lack of grading may have resulted in Brynn feeling more comfortable to use everyday language to make sense of science content. The ability to be able to use such language at the camp may have helped Brynn feel more comfortable to engage in conversations throughout the camp. Through her use of everyday language, Brynn eventually learned to talk science and was able to achieve the intended objective of appropriately identifying the organism.

A second example of Brynn's use of everyday language further exemplified this notion. Brynn and Regan were working during the micro-organism lab to correctly identify species of plankton they viewed under a microscope. Jocelyn, the MSC instructor for this camp, interacted with Brynn and her partner to guide them in their identification activity. As Jocelyn engaged with the pair, Brynn used everyday language and gestures to convey information about cilia. The transcripts demonstrate that she used everyday language and gesturing, rather than the scientific term to describe cilia and the characteristics of the plankton.

> Brynn: Okay. I thought it was ((points in the book)) but I couldn't see the things ((gestures with her hand)) that they have.
>
> Jocelyn: ((looks in the microscope to view what Brynn was describing)).
>
> Brynn: We have like, three [plankton] in there.
>
> Jocelyn: I don't know what you're talking about.
>
> Brynn: But, yeah, that's what's like, confusing me. Cause like I have- ((points to the description in the field guide)).
>
> Jocelyn: You have like one...two, three-
>
> Brynn: Yeah, I have the long ones ((gestures with her hands to demonstrate)) like the… ((gestures again by flipping her hands back and forth)).
>
> Jocelyn: Kind of like a mushroom cap.
>
> Brynn: "Yeah. And I can figure out, cause like I know it was this one, but then like-"
>
> Jocelyn: Umm-hmm. ((nods her head in agreement)).
>
> Brynn: But then I like, then I saw that the thing, on the ((gestures with her hands by waving them back and forth)) sides hang out, to like the sides ((motions with her hands to demonstrate how they hang out the sides)).
>
> Jocelyn: It looks like you have cilia here which means you would see the fanning ((gestures with her hands back and forth to demonstrate fanning)) basically.
>
> Brynn: So-

Jocelyn: This is also kind of like an aerial view and they're not necessarily in that position ((looks in the microscope again))…So that in there is what you're viewing.

Brynn: Oh…So they are, the Atlantic Crab?

Jocelyn: Umm-hmm.

Through this interaction, I argue that Brynn used everyday language, rather than scientific discourse, to make sense of the content in the field guide to correctly identify the plankton sample. She used words such as, "things," "long ones," and "hangs out" to identify the defining characteristics of the plankton they were viewing. Further, she used gesturing and hand motions to exemplify for Jocelyn the features of the plankton that she viewed in the microscope. Jocelyn supported Brynn's use of such language and gesturing and used them as well with phrases such as, "looks like a mushroom cap" and use of a hand motion to show how the cilia fan out. In using everyday language and gesturing, modes of communication which were familiar to Brynn, she was able to meaningfully engage in a science learning conversation and appropriately identified the plankton specimen.

As a final example, I present Brynn's conversation with her partner, Regan, to correctly identify rough tangleweed. The girls were very playful during this identification activity. I observed them joking with one another and playing with the organism. Often, they would take the organism out of the bowl or they would reach their finger in to poke the organism. While doing so, they giggled and teased one another. At times, they would refocus and return to reading descriptions of the organism. The activity transpired in this way:

Brynn: Oh, look. Oh my god, it doesn't close. ↑The little one closed. ((Brynn uses her pinky finger to reach in the bowl and touch the organism.) Eww, it's squishy. It's squishy. ((Brynn whispers something in Regan's ear)).

Brynn: It doesn't close. Okay, whatever. Um- ((Brynn scratches her head and looks around before grabbing the field guide.))

Regan: Okay, let's read…Would it be- ((moves the bowl with the organisms in it over))

Brynn: I think it would be, um…

Regan: Do you think its coral?

Brynn: Um, I think it's∨[??]…((let's look in here)).
((Brynn flips through the field guide as Regan observes her. Regan stops her at one point and points to a description in the field guide.))

Regan: I think it'd be like…this one.

Brynn: Well, I don't think it, maybe it's [??].

Regan: Well, let's see. ((Points to the description and together they silently read.) Um…[??] ((Regan reads the description out loud as Brynn evaluates the description as compared to the features they are observing on their organism).

Brynn: No. (I don't think that's it). ((Brynn returns to the book and flips through it a bit more. Regan stops her on one page and points to a new description.))

Regan: Maybe it's this.

Brynn: It just…says. ((The girls read to themselves.)) Alright, I really…I really want to feel it. But there's like, stuff in here. ((Regan reaches to put her finger in the bowl.))
Brynn: No, be careful. It's like, the sharps over here. ((Brynn points to features of the organism that she believes are sharp and harmful for Regan to touch.))

Brynn: K, feel this. ((Regan reaches in to touch the organism with her finger.)) Pull it out of the water. ((Regan grabs part of the organism and lifts it up out of the bowl as Brynn helps her. They both observe the organism.))

Regan: [I don't, I don't-].

Brynn: [You're not holding on]. ↑Oh:::h. They're not just like regular branches, they have like ridges in them. That's what's missing ((from the description they are currently reading)).

Regan: Oh, it's [??].

Brynn: ↑Yeah:::h.

Regan: Let's see. Branches roughened with fine bumps. Pale brown. I guess so. Yeah. One foot. ((Regan reads the description in the field guide. As she reads, the girls periodically evaluate the description as compared to the features of their organism. After reading each section of a description, they look up and observe the organism in the bowl and then return to reading in the field guide)).

Regan: I think so, yeah. I think it's, uh, rough tangleweed.

From this excerpt, I argue that Brynn and Regan were using an activity structure that was more aligned with everyday use of language than scientific discourse or ways of interacting in the classroom. In this science camp setting, they were playful, laughing and teasing one another. They played with the organism by poking at it and removing it from the bowl. Their playfulness might be considered off-task behavior in the classroom, but in this instance, it helped them determine the correct identification of the organism. Through playing with the organism, they noticed an important, defining feature that helped them correctly determine its identification. In describing the organism, they used everyday terms such as "sharp," and "ridges" which differed from the scientific terminology to describe the organism. However, their use of these terms helped them to make sense of the description in the field guide, "Branches roughened with fine bumps" (Gosner & Peterson, 1999).

From these examples, I suggest that Brynn used everyday language during learning conversations to make sense of the technical, scientific terminology. Further, she used language activity structures during the conversations that were not technical and more closely aligned with everyday ways of using language. The use of everyday language and structures that were familiar served as a scaffold for Brynn that eventually led her to appropriate scientific discourse. As Brynn started using scientific discourse and aligning her practices with the community of science, her identity as a learner of science developed. She came to see herself as the type of person that was able to use scientific language.

At times during the learning conversations, Brynn used language to position herself in ways that aligned with scientific practices. In particular, Brynn used language to position herself as the type of person that wanted to hold and interact with the organisms and was not afraid to do so. In the learning conversation that follows, Brynn positioned herself as wanting to hold a hermit crab during the organism lab. She distanced herself from her peer, Paula, who was afraid to hold the crab and thought it was gross:

Brynn: Put (your) hand out.

Paula: Oh, no. It's pulling out.

((Hannah has reached into the bowl and is going to pick up the crab.))

Paula: Look at it, look at it. Oh my god. ((Raises her hands up in exasperation and turns away as though she doesn't want to watch Hannah touch the crab. Brynn laughs))

Hannah: Chill. ((Brynn giggles)).

Brynn: It's so cool!

Paula: That is the grossest thing I have ever witnessed.

Hannah: Why? ((Brynn and Hannah are taking turns reaching in the bowl to touch the hermit crab.))

Paula: Oh god. ((Paula flips her hair over her face and covers her eyes with her hands. Brynn is holding the hermit crab and has pulled it up out of the bowl.))

Kaylee: ((Brynn, put it back))

Paula: OH NO! ((Hannah laughs.))

Allison: [??] ((Brynn leans over with the hermit crab to show Allison. Hannah leans in to get a closer look.))

Brynn: AHH! ((squeals and then laughs)).

Paula: NO!

Brynn: IT'S A HERMIT CRAB! It's not going to eat you. [??]
Paula: No. ((plays with her hair)). No. No. ((Paula gets up and stands away from the group as she watches Brynn play with the hermit crab)). Oh my god.

> Brynn: Oh my god, ↑it's just a hermit crab. ((To the girls that were afraid of the hermit crab)): You guys should have stayed home.

In this conversation, Brynn distanced herself from the other girls that were afraid of the crab and instead positioned herself as the type of person that would hold and touch organisms. She appeared to view this as an aspect of science as she commented that the other girls should have stayed at home if they didn't want to touch organisms. In this way, Brynn saw touching organisms as an obvious part of a marine science camp. By commenting and demonstrating that she enjoyed the organisms, she was aligning her practices with those of scientists, some of which interact with organisms as part of their profession. Brynn positioned herself as interested in organisms which showed that in some regards, she was identifying as a learner of science.

Brynn's increased participation in the learning conversations during the camp seemed to influence her identity as a learner of science. She began to participate more often in the conversation as the camp progressed and frequently asked questions of her peers, teacher, and the MSC instructors (field notes, May 2010). Mr. Malone also noted a change in Brynn's confidence and participation,

> …the progress, as the process, um, moved forward, um, I believe that I've seen [Brynn] take on more of a scientific, um, view of the, um, instruction and of the activities which she was going through. She started to become more a part of it and more confident with what she was doing" (post-camp teacher interview).

Later in the interview he continued,

> I felt, to me, that her questioning was more on par and it felt like she was grasping the concepts as opposed to, um, being wowed by them as much. I can't explain it. She, she tends to be, like, very animated. She's very active

> and alert and all that stuff. But, she can be <u>off-target</u> a lot. It just seemed to me that she was just a little more on target…it seemed to me like, you know, toward the end, the last activities, um, the, the second to last day before we left, she seemed to be more in tune with what was going on. Um, it's, kinda interesting, because I'd almost like to see her in that kind of environment for like a whole week or something. I think I'd be really curious how she would end and where her confidence would be (post-camp teacher interview).

The experience of the science camp, for Brynn, positively influenced her confidence, an important aspect of her identity as a learner of science. As her identity as a science learner developed, her increased confidence resulted in greater participation and engagement with science activities and discourse. She was more confident to ask questions and engage with the science content.

Brynn attributed her development to several aspects of the camp program. In her interview, she commented about how she felt more comfortable talking with her fellow students and asking questions. This resulted in Brynn's identity development as a learner of science. Brynn commented that working with her peers in groups influenced her science learning,

> Like, communication like Dale said, and like, Hannah and I said with the making new friends and working in groups, I think that's, we've opened, we've all liked opened up and become a lot more dependent on our friends and the groups we were in and the group members (post-camp focus interview, May 2010).

Later in the interview, she reiterated this notion,

> Umm, Brynn. I agree with both Dale and Hannah that (·) you, instead of being really independent you just, looking from a book and (·) writing it all down yourself, I think that the experiences, has (·) like (·) changed me to like depend on other people. And, just like Hannah said, I think I've like, opened up a little bit more. And I'm able to, like, be a little bit more, like, free, like, my thoughts, and, like, my group members and stuff. (post-camp focus interview, May 2010)

Brynn described that this opening up that she referred to was a result of the opportunity to work closely with peers and make new friends through both the science activities at the camp as well as the leisure activities and the unique aspect of living together with classmates.

Brynn also attributed the hands-on nature of the camp and the field experiences to her identity development as a learner of science. She commented on the real-life aspect of the camp and stated,

> I think that, going on these trips, like, the, um, the counselors, um, they as we were on these trips, they'd point out, like, "oh, what is that? It's like, an embryo dune," or something. And, like, even though we were having fun, we were learning, and we were putting it in like a real-life situation or like a real experience (post-camp focus interview, May 2010).

She also mentioned the influence of the field experiences,

> And, and it-, like, it, from the experiences, like the marsh and everything, um, I think I learned a lot more because I was actually doing it, and I was actually out there. And, since like, I'll remember the experience, but with that experience, I'll remember, like, what we need to solve and all that (post-camp focus interview, May 2010).

Brynn felt that the hands-on aspects of the camp and the field experiences influenced her identity as a learner of science. She enjoyed actively doing science as well as the real-world context of the field experiences. She described,

> I definitely think um, the first we were interviewed, or before I even came, I wasn't really sure about like, since I'm not like really the science type of person, um, I'm more of just like, sitting there, taking it all in type of person. And, I really think that like, this trip has shown that, like, science is different than what it is in the classroom

These opportunities helped Brynn to see that science was different than what she perceived in the classroom.

Brynn's identity further developed with regard to her career choices. When interviewed at the start of the camp, Brynn stated that she was considering teaching as one career option. She suggested that to some extent, there would be opportunities for her to engage in science during this career because science would be one of the topics that she would teach. At the end of the camp, Brynn noted that her ideas about future career choices shifted because of the informal science education camp. When asked in the post-camp focus interview (May 2010) if she would pursue science as a career, Brynn stated, "I think I've definitely changed, because (·) I think that instead of telling people ↑about it, I actually want to go out ∨and be doing it." Brynn attributed this change to experience-based focus of the science camp. When asked about why her ideas about career choice changed, she commented,

> I think actually going out there and applying, like, the facts that we learned in the lab or actually sitting, like, almost like, in the classroom, () that (·) going out there and applying it, to like, the real-world and actually being able to,

> like, perform the experiments in, like, an environment. (Post-camp focus interview, May 2010).

Brynn enjoyed the hands-on nature of the science camp and the opportunities to situate science in the real-world. She now viewed that a science career would provide opportunities to be in the environment and be actively performing experiments. The informal science education camp program positively influenced this aspect of her identity as a learner of science.

Following the camp, there were still areas in which Brynn's identity as a learner of science could grow. Specifically, there were times when Brynn resisted certain aspects of aligning her practices with those of science such as resisting scientific discourse or scientific methods. Toward the end of the camp, for example, the participants went on a field experience to Tom's Cove which is an intertidal ecosystem. On the trip, Jocelyn points out a prominent grass, known by its scientific name as *Spartina alterniflora*, and asked the learners to record this name in their field books. Brynn asked Jocelyn if she could just write "grass" instead of the scientific name. In another example, Brynn was attempting to identify an organism during the lab. The participants were instructed as to the procedures scientists use for identifying organisms with the field guide. Instead of using these procedures, Brynn chose to look at the pictures and attempted to guess the identification. Both of these examples illustrate ways in which Brynn still resisted alignment with certain practices of science. This highlights one area for improvement with regard to Brynn's developing identity as a learner of science.

Although there were still areas for growth, Brynn's identity as a learner of science developed at the informal science education camp, particularly with regard to her increased confidence in her abilities as a learner of science. Her improved confidence resulted in greater participation in the science activities during the camp as well as her participation in the learning conversations. She attributed these changes to the opportunities the camp program afforded for her to engage in conversations with her peers during group work. The group work enabled Brynn to participate equitably with her peers in conversations during which she was able to use everyday language and gesturing, activities structures that may have been more familiar to her than those typically used in the classroom. She suggested that the camp made her comfortable and "opened her up." Further, the hands-on nature of the camp as well as the opportunity to learn outside in a real-world context positively impacted her identity as a learner of science.

Summary. Prior to the science camp, Brynn's expressed an interest in science, particularly with regard to learning Earth science and marine biology. However, she lacked confidence in her abilities as a science learner and was tentative about learning science. She perceived that others would not see her as a learner of science. At the science camp, Brynn was observed using everyday language and familiar activity structures to make sense of the science content. This helped Brynn to engage in the science learning conversations and see herself as a learner of science. She also used language to position herself with regard to her peers, specifically to demonstrate that she was the type of person that enjoyed learning about and interacting with organisms. Brynn believed that the science camp and the opportunity to converse with peers helped her to feel comfortable in the setting which further influenced her identity as a learner of science. The science camp program helped to develop areas of her identity as a learner of science. She developed greater confidence in her abilities as a learner of science and deepened her interest in learning about science. In addition, the science camp program prompted her to consider pursuing a career in science.

Hannah: "I even ate a live shrimp!"

Like Brynn, Hannah's identity as a learner of science developed most notably with regard to her confidence as a learner of science. Hannah was a white female that participated in the science camp program as an 8th grade student from Patriot Middle School. She was relatively tall compared to her fellow participants and had long hair which she often wore in a ponytail. Hannah was athletic and participated in such sports as soccer and lacrosse. Hannah had a bit of a quiet presence about her although she was not shy. That is, she did not avoid social interactions with others but was not as outgoing or as outspoken as Brynn or the other case participant, Dale. The comments made by her classroom science teacher , Mr. Malone, supported this notion. He commented that Hannah at times stood back which he attributed to her lack of confidence.

Hannah came to the informal science education camp as a learner who was already interested to some extent with science. In her pre-camp interview (May 2010), Hannah made the following statement: "I find myself liking science and um, (•) I wouldn't say I'm the best at science, but I'm working for it, and I love to learn about it." This idea was echoed in her journal entry where she wrote, "Overall, science is a class I enjoy attending" (Day 1 journal entry, May 2010). Although Hannah expressed that she liked science, it was an area of her identity as a learner of science who was just emerging. Hannah explained that in previous years, she did not enjoy learning about science. She wrote in her journal, "In earlier years, learning science [has] been not as interesting as this year" (Day 1 journal entry, May 2010). Hannah also mentioned this in her interview and commented,

> ↑Previous years, I haven't had a great (•) time with science. Um, I think (•) maybe I, stepped up more to the plate. Last year, I just wasn't really interested

> in science. Sixth grade was just, not very interesting. And this year, I think we're learning very interesting, umm, topics and I that's gotten me more, um, interested. (pre-camp focus interview, May 2010)

For Hannah, the topics introduced as part of 8th grade science curriculum at her school were more interesting. She enjoyed the topic of Earth science which she believed helped her to develop an interest in science. Hannah explained, "I personally loved the Earth science because I love, I think it's fascinating, really, and I love learning about what's out there and I just think it's (•) totally amazing how, it, the universe goes on and on" (pre-camp focus interview, May 2010). Hannah's interest in Earth science was also evidenced in enrollment in an advanced science course, astronomy, for the following year (pre-camp teacher interview, May 2010). Although ultimately Hannah was not approved for the course by the high school due to her math abilities, her initiative to enroll in the course demonstrated her developing interest in science.

Prior to the science camp program, Hannah lacked some confidence in her abilities as a learner of science. Her classroom teacher identified that in general, Hannah was a confident person but this was not necessarily true with science. In describing Hannah's confidence in science, Mr. Malone commented, "she lacks a little bit of confidence but she will definitely participate. Um, she's probably much stronger than she would believe herself to be" (pre-camp teacher interview, May 2010). When prompted what evidence made him believe Hannah lacked confidence, Mr. Malone explained,

> I would say, uh (•), her (•), her slowness to answer questions or participate or her body language when she does participate…Uh, you know, th-, the kinda look with the head turned with the eyes squinted like 'are you tryin-, I don't

> know', you know, just that lack of, and she'll get the right answer, but she's not quite as confident with it.

Later he continued this line of thought,

> I think her confidence in participating may be a little bit, um, she may be a little bit, um, she may be a little bit stand-offish because of that confidence which she might, I mean I might have to prod her for answers and she might actually know them, but she's afraid, 'maybe I don't know it, maybe I'll stand back here a little bit.' (pre-camp teacher interview, May 2010).

The classroom teacher reiterated this lack of confidence for Hannah at several points throughout the interview. He perceived that her identity as a learner of science was largely influenced by her lack of confidence in science.

Hannah also pointed out her lack of confidence in her abilities as a science learner. She mentioned this lack of confidence in both her journal entries and her responses during the interview. In her journal, she writes, "Science for me is difficult to grasp at first, but I am able to use it once I have it fully memorized" (Day 1 journal entry, May 2010). This theme surfaced in Hannah's interview as well. Hannah commented,

> I wouldn't say I'm the best at science, but I'm working for it, and I love to learn about it and I like (•) I'm not really good at memorization, so it's kind been a trouble, well not a trouble, but a problem this year. (pre-camp focus interview, May 2010).

When further prompted, Hannah added,

> Umm, mainly because this year I've found that we have to memorize a lot of terms and, um, formulas (•) and I'm good at the so-, solving the formulas, but

its the memorizing and the setting it up that I have trouble with. (pre-camp focus interview, May 2010).

From these statements, we see that Hannah lacked confidence in her abilities as a learner of science. She believed that she had difficulty memorizing the information which led her question her abilities as a learner of science. As a result, Hannah saw herself as an average student. In the interview she remarked, “I think (•) people see me as an average student. I don’t (•) know all the answers all the time, but (•) sometimes I know the answers. I don’t think, I’m…above average. I think I’m just…a regular (•) average girl” (pre-camp focus interview, May 2010). When asked what made her think people saw her as average, she described,

> I base it on, um, I base it, I’m basing off of how often [the classroom science teacher] calls on me and how often I answer his answer ↑correctly. Um, yes I am always on task, and I get my work done, but um, um, it’s just still the memorization thing and knowing the answers off hand. (pre-camp focus interview, May 2010)

Hannah’s perceived abilities as a learner of science are based on traditional ideas of school science where the teacher lectures and uses triadic dialogue (teacher question-student response-teacher evaluation). Hannah noticed that she was not called on in the classroom often by her teacher and when she was, she found that her answers were incorrect. Because of this observation, Hannah believed she was just an average student and lacked confidence in her abilities as a learner of science.

Although Hannah lacked confidence in her abilities as a learner of science, Mr. Malone believed it was an area in which he saw Hannah developing. He thought that she was “progressing” with her confidence in science and he cited her enrollment in an advanced course as evidence of this improvement. He stated, “I think overall she sees herself as a good student or she never even would have considered, in science, to consider herself taking more advanced classes in science" (pre-camp teacher interview, May 2010). He later added,

> Um, the fact that she wanted to take astronomy as an elective next year (•) um, (•) indicated to me that she really wants to move ahead and, uh, as I said she wasn't eligible for it because of her math level that she's at now. But I do see her as a, a future learner, a, someone who may be coming in to her own with, with the science and understanding, 'wow, this is actually pretty cool, this isn't so bad, this is not so hard, I can do this.' (pre-camp teacher interview, May 2010).

Mr. Malone's statements highlighted Hannah's developing identity as a learner of science, particularly in terms of her confidence.

The learning conversations at the informal science education camp influenced Hannah's identity as a learner of science. By engaging with her peers at the science camp, Hannah was able to take risks which she claimed helped her to develop as a learner of science. Hannah suggested that the learning conversations with her peers encouraged her to try new things such as eating a shrimp during the intertidal field experience. Hannah indicated that her new willingness to take risks helped her to identify as a learner of science. In the proceeding section, I provide the conversations that Hannah cited influenced her willingness to take risks.

During the intertidal field experience, the participants used seine nets to collect organisms. The participants collected many organisms in the seine net during the activity, including organisms such as shrimp. On this particular trip, the educators explained that the raw shrimp were edible and encouraged the participants to try the shrimp. Hannah was hesitant at first to partake in this event but was eventually influenced by her peers during their conversation about the shrimp. She ended up tasting the shrimp and was very proud that she tried it (Intertidal field notes, May 2010). In her journal reflection that day (Day 2 journal entry, May 2010), she wrote, "I even ate a live shrimp!" Similarly, on the marsh field trip the participants learned about a marsh plant, *Salicornia virginica*, commonly known as salt wort. During the marsh field experience, the educators explained that salt wort was edible and tasted salty due to its expulsion of salt from the water it takes in from the marsh. The participants were permitted to try the salt wort to note its salty taste. Hannah again was willing to take a risk and put the plant in her mouth during the trip to taste its saltiness (Marsh field notes, May 2010).

Another example of this notion of risk taking surfaced during the organism lab. Hannah was working with a group of five girls and Brynn decided to pick up and hold a hermit crab. As Brynn picked up the crab, several of the girls expressed fear in touching the crab. Initially, Hannah was hesitant to hold the crab as well but was coaxed throughout the conversation by her peers to touch it.

> Brynn: It's a hermit crab.
>
> Allison: Eww. ((laughs)).
>
> Brynn: No, I'm=
>
> Hannah: =I can ((feel it)).
>
> Brynn: ((Smiles and laughs at Hannah. Hannah seems to be attempting to touch the hermit crab through coaxing from Brynn. Hannah eventually reaches into the bowl and picks up the crab.))

Before the science camp, Hannah may not have seen herself as a learner who would take risks and try new things. Conversations with her peers during the science camp helped Hannah to try new things such as tasting shrimp and salt wort as well as hold organisms of which she was previously afraid. Trying these things helped Hannah to see herself as a learner of science as she perceived these were activities in which scientists partake.

Hannah explained this new willingness to take risks during the post-camp focus interview. She stated, “I’ve sort of, um, sort of stepped out of my comfort ↑zone. And, (·) I’m finding that I’m ↑okay with that, cause, like yesterday I ate a live shrimp, but, (·) I was okay with that afterwords” (post-camp focus interview, May 2010). She added that others may notice this new willingness to take risks. Hannah stated, “I think (·) maybe, people (·) see me as (·) maybe being more adventurous” (post-camp interview, May 2010).

When asked to explain what aspects of the science camp promoted this adventurousness, Hannah indicated that the freedom of the camp helped her to open up more and take risks. During the interview she stated, “Um, dur-, while I was here, I’ve sort of, um, sort of stepped out of my comfort ↑zone. And, (·) I’m finding that I’m ?okay with that” (post-camp focus interview, May 2010). Later in the interview, Hannah added,

> By having my friends↑here, and I’ve made new ↑friends. Um, I felt more comfortable ↑here, (·) um, instead of not having anyone here. But, um, (·) I think it gave me (·) the a (·) the (·) push I needed, to do some of these ↑things (·) that I normally wouldn’t have done. So, ˅it helped me in that area. (laughs) (post-camp focus interview, May 2010)

This idea was also repeated throughout the week in her journal entries. On day 2, Hannah reflected, “While in the camp setting, I feel more comfortable because it is a more free feeling” (Day 2 journal entry, May 2010). The following day, Hannah again brings up this notion, “I believe I am able to express myself more in a camp setting than in a classroom. In a classroom I feel more confined. I also had good talks with my friends and leaders" (Day 3 journal entry, May 2010). This comes up again in her final entry. She writes, "By going on this trip, I have opened up more and I am able to see myself as a more interactive learner. I feel not a lot of pressure here. This is a place where it is fun to learn" (Day 4 journal entry, May 2010). The data that Hannah provides in her journal entries and interview responses continually highlighted that she believed the informal science education camp was a more free environment than the classroom, one in which she felt more open to taking risks.

The freeness and supportive environment of the science camp further helped Hannah to feel comfortable participating in the learning conversations. As the program progressed, Hannah started to open up more and participate more frequently in conversations with her peers. Hannah brought this up during the interview and stated the science camp felt more comfortable to her. In this way, she felt more willing to engage in the conversations. Hannah explained, "↑I think maybe because I feel more ↑free here. I don't feel so confined in a, tight, classroom. And, you have (·) group members when you're, you're not like being watched all the time by a teacher" (post-camp focus interview, May 2010). This comment seemed to suggest that in the classroom, Hannah felt as though the classroom teacher was watching over her in an evaluator sense. She felt pressured by this focus on her individual performance. Mr. Malone speculated that this might be an area where Hannah felt pressure. He noted that Hannah might say, " 'I don't want to mess up. If I mess up, Mr. Malone's not really going to think I'm a science person'." (post-camp teacher interview, May 2010).

At the science camp, Hannah felt comfortable in working with peers in which responsibility was spread among group members and no one individual was held accountable. Hannah stated, “And (·) I just find that, (·) I can (·) as Dale said, rely on others and ask them for help if (·) want it. And, sort of trust them” (post-camp focus interview, May 2010). Hannah provided a specific example of this group aspect that she believed first took place on the research cruise. She described,

> To me the boat trip was, um, (·) the most, (·) um…defining moment too. Because it was the first time we all could, uh, see each other work together as a group. And, um…to see (·) how the experiments (exhales), like how we all work together and how we (·) uh, did the-, performed the experiments together and (·) it’s just (·) it made everyone (·) feel (·) kind of, ↑together I just almost think. (Post-focus interview, May 2010).

This example provided by Hannah demonstrated that activities during the science camp program afforded participants occasions to work with their peers. Being able to work together and share the tasks helped Hannah to feel less under the microscope of the teacher. Therefore, she felt less pressured and more “open” and “comfortable” in this setting (post-focus interview, May 2010).

The participants indicated that they did not have many opportunities to work with groups in the classroom. They suggested that most of the time, they worked individually during activities in the classroom. The supportive environment of the science camp (e.g., non-assessed, more student agency, new teacher and student roles and procedures) and the opportunity to work in groups helped Hannah to feel more comfortable in this setting and participate in conversations more frequently. She described, “I think (·) maybe, people (·) see me as (·) maybe being more adventurous cause in the classroom I may be kinda↑ quiet. And, um, (·) so, I think maybe that’s showing people that I ↑can::: express myself more” (post-camp focus interview, May

2010). Her new role as a frequent participant in the conversations helped Hannah to see herself as a learner of science.

I observed Hannah participating in conversations with her teachers and the MSC educators during the science camp. At certain times during the science camp, these conversations were more equitable than they might have been in the classroom. Specifically, Lemke (1990) suggested that in the classroom, teachers often rely on activity structures such as triadic dialogue and teacher monologue (e.g., lectures). With these types of activity structures, the teacher is in a position of power. The teacher has power to evaluate students' answers during triadic dialogue. During lectures, the teacher maintains power by dictating the topics and content. However, in the science camp setting, these activity structures were less prevalent. Instead, learners such as Hannah participated in conversations with their teacher that were more equitable. For instance, I observed the teachers asking Hannah questions about the content to which Hannah responded with an answer. The other teachers on the trip were not teachers of science but rather were teachers of other content areas such as physical education and special education. Further, the content of marine science was outside of the classroom science teacher, Mr. Malone's, area of expertise. Thus, the participants were positioned as equally knowledgeable in this setting. When a teacher was observed asking a question of a participant at the science camp, they did not know the answers and were genuinely asking for an explanation to their inquiry. This is different than in the classroom where teachers often know the answers and ask students questions to promote recall.

As an example, I present an episode of Hannah's participation during the organism lab. Hannah was working with her group members to correctly identify a species of seaweed. A teacher comes over to interact with the group. The teacher does not know the correct identification of the organism either and works with the girls to correctly identify the organism.

> Mrs. Carnetti: Do you guys have sea lettuce? ((The group has already identified sea lettuce. Hannah points to the plate of algae and indicates for the teacher which of the samples was sea lettuce)).
>
> Hannah: That one is.
>
> Paula: We don’t really know what to do after we've found it. ((The group moves on to ID a new algae sample)).
>
> Hannah: We looked in here. ((Hannah points in the book to the descriptions they have been reading.))
>
> Mrs. Carnetti: You found it in here? ((Points to the field guide. The teacher starts to work with the girls to identify the new species)).
>
> Hannah: We found it in here.
> ((Teacher takes the field guide and begins to read through the descriptions the group has been evaluating.
>
> Mrs. Carnetti: [??] ((Reads a description in the book and compares it to the sample they are attempting to identify)).
>
> Paula: ((points to the algae.))
>
> Mrs. Carnetti: Is it a sponge? ((She continues to read a description.))
> ((Jocelyn comes over to help the group. She redirects them to the appropriate descriptions in the field guide.))
>
> Allison: What’s that? ((She stands up and reaches for a new field guide. The teacher starts to flip through the new descriptions in the guide with Hannah and Paula.))
>
> Paula: Right here.
>
> Allison: Brown seaweed. ((Points to the description in the field guide.))

From this interaction, we see that the learners and the teacher are positioned as equals during this activity in the science camp setting. Neither the teacher nor the learners know the answer regarding the correct identification of the organism. The opportunity to engage in equitable conversations with the teachers may have helped reduce the power structure that is typical in the school setting. In this way, expertise was distributed amongst both the teacher and the learners. This aspect of the science camp may have influenced participants' identities as learners of science. For Hannah, this distribution of expertise may have contributed to her feelings of comfort, freedom and less pressure in the science camp setting.

By the end of the science camp program, Hannah's identity as a learner of science developed in several areas. The unique features of the science camp context were particularly influential in terms of Hannah's enjoyment in science, her views of science, and her confidence. Additionally, through the course of the camp, she maintained her desire to pursue a science career in forensics or marine science.

Hannah expressed that she had fun during the science camp and this helped further her interest and enjoyment in learning science. She brought up the aspect of fun throughout her journal entries. She wrote, "During today's activities, I had an amazing time. It was hands on and when identifying the organism, it was very interesting" (Day 2 journal entry, May 2010). In this entry, Hannah demonstrated that she enjoyed the science camp activities. She found the hands-on aspect of the camp as well as the opportunity to identify organisms interesting. The next day, Hannah writes, "Today was fun and I enjoyed getting the water to collect samples. It was interesting to see the organisms up close. It was a fun day!" (Day 3 journal entry, May 2010). Again, Hannah reiterated the notion of fun. She found the unique aspects of the science camp, particularly the novelty of getting in the water and collecting organisms, enjoyable which helped her to view science as fun. On the final day, Hannah comments, "This is a place where it is fun to learn. Overall, I had a great time and I wish to come back soon!! ☺" (Day 4 journal entry, May 2010). Hannah enjoyed the unique learning activities of the camp. She found the activities interesting and it helped develop affective dimensions of her identity as a learner of science.

The idea of fun was also mentioned in Hannah's responses to questions during the post-camp interview. Hannah commented, "This trip has been so:::o fun for me I almost don't want to leave" (post-camp focus interview, May 2010). Hannah believed that having fun helped her to learn more easily in the science camp context. She stated, "the best kind of learning is when you're having fun while doing it. And, (·) even when it's getting you involved, it's just, you can't beat it because you're learning at the same time" (post-camp focus interview, May 2010). From this quote, we see Hannah's ideas about fun in this setting. She believed the focus on enjoyment in the science camp context helped her to learn while having fun. Hannah further added, "I was able to understand more because I was actually doing the ↑activities. And, it was, (·) so much fun and I just (·) I think it was ↑so much fun. I had, a great time" (post-camp focus interview, May 2010). In Hannah's view, the authentic science activities, that is, science activities that were situated in a real-world context, helped her to have fun while learning science. Additionally, she believed actually being able to do science helped her to understand the content more easily.

When asked why she believed the science camp setting was more fun, she explained,

> It's just so much fun being away from school, not having (·) everybody in the classroom around you. It's just, a ↑great experience. I think everyone should do this, one time in their life. And, (·) it's just so amazing to learn the things that you never would of, before, about the ocean, the tides, and…plankton-, anything about (·) ocean, oceanography. And, (·) I just hope I get to come back here sometime soon. (laughs). It's so fun. (post-camp focus interview, May 2010)

Hannah pointed out the notion of novelty at the science camp setting in this quote. Specifically, the participants were able to engage in activities that they have not had opportunities for in the classroom. These novel activities helped Hannah to see science as more enjoyable. For example, Hannah indicated in the preceding quote that she learned information about topics that she might not have had a chance to learn in the classroom.

This notion of novelty comes up again in the interview when Hannah talks about the dunes field experience on Wallop's Island. On this field experience, the participants take a field trip to a naval base located on Wallop's Island. Because the naval base has restricted usage, it is a relatively untouched beach. Only members of the navy, NASA employees and MSC employees and participants have access to this beach. This unique experience to visit this private beach was influential to Hannah. She explained,

> Um, for ↑me, the most, uh, my favorite part was going on the beach and collecting the shells. Even though we didn't really do anything, um… I mean like the combing∨part on the beach. But that was, um, (·) one of my most favorite parts cause, (·) it was (·) basically, untouched, and we'll never get to go back there again. It was just (·) so amazing (post-camp focus interview, May 2010)

This statement again alludes to the novelty aspect of the science camp. For Hannah, the science camp program afforded her a unique and novel ways of learning science. She was able to explore untouched beaches and learn content that was unique and specific to the science camp setting. This novelty, for Hannah, helped influence her identity as a learner of science. Through the course of the camp, she learned to further enjoy learning science and viewed the activities as fun. The focus on fun in this setting influenced affective dimensions of her identity as a learner of science.

Another aspect of Hannah's identity as a learner of science who was positively influenced by the informal science education camp was her views of science. Specifically, Hannah initially did not see science as important in everyday life. Prior to the science camp, Hannah believed science was only used in school. When asked how she used science in everyday life, Hannah responded, "Um:::m…Uh, ↑personally, I find I use…math (•) more than science, honestly (laughing). Umm, I can't really think of a situation right now where I'm using science, except science class" (post-camp focus interview, May 2010).

Hannah's views of science in everyday life changed through the course of the science camp program. At the end of the science camp program, Hannah commented that she saw connections with science and everyday life. When asked the questions, "How do you use science in your everyday life?" Hannah responded that she agreed with her peers, Dale and Brynn, that science was important in everyday life. She offered the following example to demonstrate her new view of science in everyday life,

> Hannah: I agree with Brynn and Dale. And (·) I just wanted to add that I thought when Jocelyn mentioned that the sassa-, sassaf- what's it called?
>
> Kelly: Sassafras.
>
> Hannah: Sassafras tree, um, that they used to make root beer, actually had cancer causing chemicals, or, reactants in↑i t. And, (·) I was thinking that's, amazing that they found that out and they need science to do that. So, it's saves a lot of lives.

Hannah's developed view of science in everyday life was supported throughout the science camp program. Jocelyn repeatedly told stories to the group that provided examples of science in everyday life. The sassafras story served as one example. At other times, Jocelyn described such information as the use of diatoms (a type of phytoplankton) in toothpaste. On the marsh trip, she described how during colonial times, island natives ate pony meat which was naturally salted from the animal's diet of salt marsh grass. These stories and examples provided during the science camp activities helped the participants to see the importance of science in their everyday lives and further influenced their identities as learners of science.

Another notable change in Hannah's identity as a learner of science was her confidence in social situations. I noticed that Hannah developed confidence which was evidenced by her assertiveness, her increased participation, and her willingness to take on leadership roles during learning activities (field notes, May 2010). When Hannah would participate at the beginning of the camp, she would comment quietly and would back down when challenged by another group member. For instance, when she was questioned during the research cruise, she would step back from the conversation and turn to reading quietly from her field book (Research cruise, May 2010). In doing so, she was able to disengage from the conversation and let the others work out the discrepancy while she would busy herself with reading her field book.

By the end of the camp, Hannah became more assertive and even offered suggestions to the group. For example, on the intertidal trip, Hannah suggested methods for improving their sieving skills. She recommended a new area for digging that she believed might be more fruitful for finding organisms (Intertidal field notes, May 2010). She also discontinued her habit of moving away from her group to read the field book. During the final activities of the science camp, I did not note this happening any longer for Hannah. I also observed her taking a leadership role during these activities. While sieving on the intertidal trip, I noticed Hannah take a leadership role and manage the activity. She directed her group members and assigned them to various tasks, demonstrating that she was now comfortable taking a leadership role at times with her peers.

Summary. Hannah started the science camp program as a learner who was developing interest and enjoyment in science, especially in Earth science subjects such as astronomy and marine biology. However, Hannah lacked confidence in her abilities as a learner of science as evidenced by her comments, Mr. Malone's comments, and her reflective journal entries. Prior to the science camp, Hannah was already considering a career in science as a marine biologist or in forensic science. At the science camp, Hannah commented that she felt free, less confined and more comfortable. She felt less pressure which she believed was because she was not under the watch of the teacher. Hannah had opportunities to engage in equitable conversations with her teachers at the science camp which may have further influenced her feelings of comfort in this setting. Hannah stated that the opportunity to engage in conversations with her peers at the science camp influenced her willingness to take risks. The hands-on and experience-based nature of the science camp activities prompted her to view science learning as fun and enjoyable. Several aspects of her identity as a learner of science developed throughout the science camp program. Hannah developed confidence in her abilities as a learner of science as well as her confidence to engage in social interactions. She came to see that science learning could be fun. Her views of science developed in that she came to see connections with science in everyday life. Finally, she maintained an interest in pursuing a science career.

Dale: "They saw me as an independent power keeper"

The case of Dale provides a different view of identity development as a learner of science at an informal science education camp and contrasts with the experiences of Brynn and Hannah. Like Brynn and Hannah, Dale also attended the science camp program as an 8th grade student from Patriot Middle School. Dale was a white male that was average sized, had dark hair and braces. He was considered by himself and others as athletic. He participated on the soccer team and was described by his teacher as a very well-rounded student. Dale believed that others considered him an over-achiever and his peers commented that Dale was smart and achieved much success in school.

Dale began the program as an individual who already identified as a learner of science yet he still developed as a result of the science camp program. His father was a doctor and Dale also saw himself pursuing a career in the health sciences and eventually doing medical research. Dale was very confident in his science abilities and felt he learned best through lectures. In the initial interview before the camp program, Dale's confidence in himself was evidenced by his domination of the conversation and his quickness with his responses. He took leadership during the conversation and was assertive during the interview. He articulated his confidence in science and described himself as good at science, particularly with regard to memorization of facts. He stated in his initial journal entry:

> I achieve exceptional grades in science…I am extremely confident in my [science] abilities…I am extremely confident in my ability moving forward. I believe my memorization ability will be vital and I have the work ethic to succeed no matter the difficulty of the topic. Science could be classified as a talent of mine. Yet I feel science is on the basis of writing and mathematics, both of which I have strengths in. Therefore, I am successful in science" (Day 1 journal entry, May 2010).

Brynn and Hannah commented that Dale was often called on in class by their teacher because he usually knew the answers to questions or had his own questions to ask the teacher related to the materials (pre-camp focus interview, May 2010).

When I prompted Dale to articulate his reasons for believing he was successful in science, he described that he performed well in science and believed that he asked more in depth questions than his fellow classmates. He talked during the pre-camp interview about how his skills in science were more advanced than his peers. Initially, he commented, “I guess I would be considered an overachiever…I would say people think of me as an overachiever, maybe a little bit over the top” (pre-camp focus interview, May 2010). To explain this characterization by his classmates, he indicated that he asked more advanced questions and explored the content more in depth. Dale described, “every day during class I guess I raise my hand and sometimes even have side conversations with [the classroom science teacher]. And, some of my questions are…they’re farther in to the topic than…we are discussing in class” (pre-camp focus interview, May 2010). Dale suggested that his questions were more advanced and in-depth because he explored topics on his own. He stated,

> I mean I, I have books about science that I read all the time, I just think I have, I ask those questions every day that would help me better understand or have more knowledge on that topic and just those questions accumulate to me having a greater knowledge and would put the pieces together for understanding. (pre-camp focus interview, May 2010)

Dale positioned himself as an “overachiever” based on his performance in school science class relative to the other students. In Dale’s view, he performed better because he had greater knowledge but also because he was good at memorization. He described this aspect of memorization, “I see myself this year in science as more of a memorization rather than analysis of topics" (pre-camp focus interview, May 2010). Dale expressed that he was good at memorization because he had learned memory techniques. Dale commented,

> I've found I've worked, a technique that's important, I, I use for memorization is I actually write it out myself and put it into your own words you're able to (•) remember the topics even better than if it's put in the review sheet for you. And, that, aspect I think put it down and spend the time, I work towards it. (pre-camp focus interview)

Dale's statements during the pre-camp interview highlighted his view of himself as a learner of science. His success in science was largely framed by school science and his ability to memorize science content to respond to teacher questions and perform on tests. Dale further assumed that his interest in science has helped him to learn the topics more in-depth compared to his classmates. Because of this in-depth knowledge, Dale believed he was able to ask the teacher more advanced questions of the teacher.

Prior to the science camp, Dale identified as a learner of science. His confidence in his abilities as a learner of science was evident during the pre-camp interview and during the science camp activities. Dale dominated the pre-focus focus interview and was assertive with his responses. Whereas the girls spoke softly and participated less often, Dale quickly jumped in to the interview conversation and spoke loudly with an unwavering voice. This confidence surfaced during the science camp learning activities as well. When a challenging problem or situation presented itself, Dale persisted. He was never distracted and never backed away from the challenge.

As an example, I present a learning activity that took place during the organism lab. Dale and his partner, Ella, were using a dichotomous key to identify a fish species that they collected on the research cruise for the aquarium. Dale and Ella went through the dichotomous key multiple times and checked their answer with the MSC educator, Jocelyn. Each time they checked with Jocelyn, she indicated that their identification guess was incorrect. After several iterations of this process, Ella was frustrated and abandoned the activity. Her body posture indicated frustration as she slumped over in her seat. She made an exhaling, huffing noise as if frustrated and then leaned her chin in her hands. At this point, she also handed over the dichotomous key to Dale and then turned away from the aquaria to observe the other groups in the classroom. Dale, on the other hand, continued with the activity. He took the dichotomous key and continued to go through the characteristics to correctly identify the fish species (organism lab field notes, May 2010). His persistence demonstrated his confidence in his abilities as a science learner. Dale believed he was very capable in science and knew he would eventually get the correct identification if he continued working on the problem.

This example highlighted Dale's intrinsic motivation to learn. Although Dale was very driven to perform in school and achieve high grades, he was also intrinsically driven by what his classroom teacher, Mr. Malone, described as a "thirst for it [knowledge]" (pre-camp teacher interview, May 2010). Dale pointed this out when he described that he enjoyed reading more about topics on his own (pre-camp focus interview, May 2010). Mr. Malone explained further,

> …he comes up to me and will ask me, over and over again, to go in, "can you tell me more about that?" Or he just wants to know, he's hungry for knowledge and he'll come in, you know, and always go the extra mile, you know, asks to look that up. And he'll come in and look up ten things about this particular subject that we're doing and come in and elaborate more on it, you

> know? And it's, "oh, I understand that now with the radioactivity. Um, tell me more about the beta particles." And he, he's hungry for the knowledge with the science. (pre-camp teacher interview, May 2010)

Mr. Malone offered an example to explain this motivation for learning. He described a classroom project were Dale went further in to depth to explore his own interests. Mr. Malone described,

> Uh, here's a kid who's out at the beginning of the year for a week or so, with an illness, and we were doing space mission projects in groups and he wasn't there to work with his group, so he did his own project, came in, you know, still running a fever a little bit from being sick and came in a did a <u>twenty</u> minute presentation as if he designed the mission probe, uh:::h, for this, you know, mission…He went way more in depth with that than he had to. He got up and taught the class (•) about this mission. And I was like, 'Whoa.' (pre-camp teacher interview, May 2010)

Dale's motivation to learn science was also exemplified in his attendance on the trip. Dale indicated that he did not find oceanography to be a particular interest of his but he wanted to come on the trip to learn more about the topic. These comments and examples underscore Dale's intrinsic motivation to learn about science. Although he was driven to some extent by performance, he genuinely had a thirst for knowledge which was evidenced by his willingness to go above and beyond to seek out more information for a particular topic.

Dale's alignment with scientific practices also demonstrated that he began the science camp program as an individual who in many ways already identified as a learner of science. Dale began the science camp using scientific discourse.

Additionally, he was concerned about using the appropriate methods of science such as correctly following the procedures and repeating data collection trials three times.

Dale used scientific discourse throughout the science camp program. During the pre-camp interview, Dale used scientific terms in his responses to the questions I asked. When asked about the importance of science, he used terms such as “investigated,” “experimentation,” “techniques,” “medical research,” and “trial and error” whereas his peers used the term “study.” He indicated he was interested in “psychology,” “orthopedics,” and “oceanography” while his peers indicated they wanted to study the “ocean” and “animals.” He described how science is important in everyday life and offered an explanation of “sea breezes,” “land breezes,” “pollution,” and “tsunamis.”

Appropriating scientific discourse was something that Dale maintained throughout the science camp program. By the end of the science camp, he continued to use science terminology when completing learning tasks. I present Dale’s conversation with his peers on the marsh field trip to exemplify his use of terminology.

Dale: This is a pH strip.

Carlena: ↑Eww, it’s tiny.

Dale: What?

Carlena: Like a travel size one.

Dale: Yeah. Alright, so, can you hand me the refractometer? ((Kaylee takes the refractometer out of the case.))

Ella: Can I do it?

Carlena: Wait, do we have a little, like, dropper?

Gia: Oh no, it’s in there.

Kaylee: I called it first.

Ella: Now you know for the first-

Dale: You can get the rest of the density. You've done, that test was just O_2 present. ((The group is looking in their field book to determine what data still needs to be collected)).

Ella: Yeah it is.

Carlena: So do I [??] ((Carlena is asking a question about where to record the data.))

Dale: [??] and H_2O.

Gia: Yeah=

Kaylee: =No, just the water.

Gia: You take the water [??]. ((The group is trying to correctly complete the procedures for testing the salinity using the refractometer. They are discussing that they need to get several drops of water from the marsh to place on the lens of the refractometer.))

Mr. Malone: You gotta hold it there on top.

Carlena: Here. ((Carlena bends over to help white get a sample of water. Dale starts to bend over as well. They work together to get the sample in the dropper that is primarily water and not marsh mud.))

Mr. Malone: That's pretty good. That's pretty good.

Dale: That's enough, okay. Alright, now. (•) Refractometer, add as much as you can. ((White adds drops of water to the refractometer as Carlena holds it. Dale is reading instructions and overseeing the process while Gia and Ella observe them.))

Carlena: Sorry, it closed.

Kaylee: That's okay. ((Ella takes the refractometer, turns her back to the group to face the sun, and holds up the refractometer to get a reading.))

Ella: I think it's (blue). ((Dale takes the refractometer from her and looks in the viewfinder himself for a reading. Mr. Malone stands and observes the group.)) Maybe it=

Dale: =Oh not, it's good. Um, I'd say…

Carlena: Here. ((Reaches for the refractometer from Dale.))

Dale: Salinities about…32.

Carlena: Hold on, you have to write that down.

Dale: Alright, you can- ((Hands the refractometer to Carlena. She holds up the refractometer to the sky for light and attempts to get a reading.)) [??].

Kaylee: (to Carlena) What does it say?

Carlena: Um, okay, [??]

Dale: We don't have to measure density, just salinity.

Carlena: Oh, okay.

Dale: What did you [have?]

Carlena: [same thing]

Dale: [32?]

Carlena: [Yeah.]

Dale: Alright.

Carlena: There's a fish? ((Ella has walked away from the group and seems to indicate there is a fish where she is standing. Dale, Carlena, and Gia walk over toward her.)) There is?

Ella: Well, it's gone now.

Dale: We still have to mark that under flora and fauna.

From this episode in the marsh, we see that Dale continued to use scientific terminology throughout the camp. Dale was observed using terms such as "pH test strip," "O_2," "H_2O," "refractometer," "salinity," "density," and "flora and fauna." In the dialogue presented in this episode, we see that Dale used scientific terminology more frequently than his peers and illustrates Dale's alignment with scientific practices.

Dale was concerned about aligning his practices with those of scientists. For instance, Dale was concerned about properly recording the data in the field guide. On the research cruise, he would repeatedly check with his group member to ensure that they had appropriately recorded the data. He would check their recordings with Jocelyn to make sure they had recorded the data correctly. Dale was also concerned with repeating the trials three times to improve the accuracy of the data. When the group was testing pH at the water quality station on the cruise, Dale directed the group members to repeat the trial an additional two times (Research cruise field notes, May 2010).

This alignment for Dale was maintained throughout the science camp program. Dale's used scientific practices and discourse during learning conversations at the science camp to position himself as a learner of science. He wanted to show that he was a member of this community and used scientific language and procedures to align his practices with those of the scientific community. Unlike Brynn and Hannah, I rarely observed Dale using everyday language in place of technical language during the science camp learning activities. Dale wanted others to see him as a learner of science and used scientific discourse and the practices of scientists to position himself in this way.

Another aspect in which Dale already identified as a learner of science was with regard to the importance of science in everyday life. Prior to the science camp program, Dale already saw many ways that science was important in everyday life. He offered the following example during the pre-camp interview,

> I use it [science] everyday. Today…So, um, we were just outside today with my friends playing whiffle ball, just out in the backyard and we noticed that the breeze was off the sea, and, we discovered where the ocean was relative to breeze, whether it was land breeze or sea breeze. And that was just like a great example of how you use science just for a specific game, just to see where the wind is blowing. Where to locate the ocean. Umm, I think science is used (•) a

> lot (•) but, not as much as math, though. (pre-camp focus interview, May 2010).

Dale noticed that he used science in everyday life such as when he was playing whiffleball. His understanding of sea and land breezes helped him understand the direction of the wind which he used to improve his whiffleball skills during the game. As another example, Dale described how science is needed in everyday to address problems such as pollution. Dale explained,

> I'm interested in (•) the pollution of the ocean I've done whole projects on pollution. I think it's a terrible issue and I'd like to go into something with, not my career as a, an (•) organization, but umm, on a side organization to stop pollution cause I know how terrible it is. Just the air we breathe going in to New York City and (•) fe-, it's difficult to breathe and I imagine, can-, cannot imagine what the marine animals are going through. And I would love to study, uh, pollution levels in the ocean just to see how terrible humans have made (•) what's around us. (pre-camp focus interview, May 2010)

Dale's view of science as important in everyday life was maintained throughout the science camp program. At the post-camp interview, he was able to offer more instances of science used every day. He explained,

> Um, science is everywhere- after this experience, I just realized going to the forest, (·) um, I pass by trees everyday. And trees usually are, they have adaptations to help them survive. Everything on this Earth has adaptations (·) and that's something about how we use science everyday. Humans adapting, how they build structures, and, make clothing, some factories. (·) And jus t as paper (·) is in a sense an adaptation for communication (·) to advance our society and in that as-pect, I realized we use (·) science at every point in

> time… The causeway construction on the causeway and using science, and they could have made that causeway so much better if they would have communicated and realized the (·) structure of the (·) gravel and then um (·) weather patterns even. And, that, science could, (·) uh, make it easier by the situations, if they were able to evaluate the land around us, especially in construction. (pre-camp focus interview, May 2010)

The many cases that Dale provided suggest that an aspect of his identity of science is his understanding of the importance of science in his life. Dale did not see science as just a subject taught in school but rather recognized its importance in everyday life.

One final aspect of Dale's identity as a learner of science upon beginning the program was his interest in learning science. In many ways, Dale found science interesting and liked learning about science topics. His intrinsic motivation to learn science and his motivation to go above and beyond (as mentioned earlier in the narrative) support this notion. Dale mentioned in the interviews that he enjoyed science. However, one area of his identity as a learner of science where there was room for influence was with regard to different areas of science. Dale suggested that although he was interested generally in science, he did not find topics such as Earth science and oceanography as appealing. Dale noted, "Personally I'm not even interested in oceanography or anything that has to do with Earth science" (pre-camp focus interview, May 2010). He was primarily interested in science topics such as psychology, human health and physical science (pre-camp focus interview, May 2010). Therefore, at the beginning of camp he identified as interested in particular topics in science but could change with regard to interest in other science topics such as Earth science.

Another area for improvement was Dale's skills in collaboration. Dale identified that he liked to have control during group work in class. He described himself in the science classroom as "an independent power keeper" suggesting that he preferred to work alone and tended to take control of group situations. Brynn and Hannah confirmed that Dale liked to take control of group situations and suggested that members of his group often checked with him to ensure they had the correct answers. At the science camp, Dale initially led and dominated group work during the early part of the program. Other group members were hesitant with their own work and would often consult Dale for his approval (field notes, May 2010).

Mr. Malone echoed this characterization and described Dale in the following way,

> Sometimes he may be a little bit overconfident... He sees himself as a scientist. He clearly, when he looks in the mirror, he sees scientist…He's very confident about, all the endeavors, um, that he chooses (pre-camp teacher interview, May 2010).

The classroom science teacher described Dale as comfortable as the star student in the classroom. He indicated that Dale was competitive with his grades and sought this star student status. In general, Mr. Malone viewed Dale as interested in science, confident in his abilities as a learner of science and very motivated to succeed.

During the informal science education program, conversation also played a role in Dale's identity development as a learner of science. For Dale, social interactions with his peers helped him to see that others were also capable of learning science. This recognition helped Dale to learn to communicate with his peers, a skill essential for participation in science. Dale recognized that prior to the science camp experience, he was controlling of science activities and often preferred to work alone because he did not trust his classmates. Dale commented, “In the beginning, of the experience, I would say that they [his peers] saw me more as an independent…um, an independent, uh, power keeper” (post-camp focus interview, May 2010). He suggested that his peers perceived him as a “dictator” in group settings. After the camp, Dale believed that his classmates saw him more as a team player,

> …before this experience, I would say that they thought I was more of a, independent, I only trusted myself in a group. But I learned to trust the people and rely on them, to, work and do ineffect-, an effective job. Because I couldn’t do all the tasks at one time. There’s a lot to, to the experiments. So I would say they more, I would say, I calmed down, I would say. And, I relaxed and I looked to trust the other group members, because, um, they’re obviously they’re capable as well. And, and, I would say I’ve calmed down (post-camp focus interview, May 2010).

For Dale, the opportunity to converse with peers in a group setting helped him to see that others were capable of successfully participating in science. At the camp setting, he was able to converse with his friends on a personal level, which helped him to relax and learn to collaborate with other students. Dale stated, “I also loved, like, I was able to focus a little bit more on just hanging out with my friends” (post-camp focus interview, May 2010). He continued,

> And, uh, it, the relaxation factor, was key with my friends, because, obviously they’re, or your always relaxed around your friends. You don’t have to be uptight around the adults of the, so I was able to open up and tr-, and, um, and then I took that into the classroom and relaxing and not worrying, not being so, um, not being so, meticulous in my work.

Dale also used non-verbal actions to convey this notion during learning conversations with his peers at the science camp. During learning conversations at the beginning of the camp, Dale would look over his peers' shoulders and double-check their work behind them because he did not necessarily trust their work. For example, during the research cruise Dale's group members used the refractometer to determine the salinity of the collected water sample. As they shared their readings with the group, Dale would take the refractometer and verify the group member's salinity reading (Research cruise field notes, May 2010). By checking behind each group member, Dale communicated to his group members that he was hesitant to accept their data readings. In the conversations that took place during activities later in the camp, Dale was more of a team player and learned to accept the input of his peers.

In what follows, I provide the research cruise activities in which Dale attempted to take control of the activities and his group members. The first episode shows Dale working with his group at the water quality station to determine the pH of their water sample.

> Dale: Okay, did we get the pH?
>
> Jocelyn: ↑You guys are waiting on?
>
> Dale: pH. ((The group sits around as they wait for the previous group move from the water quality testing station.))
>
> ((Dale pulls out goggles from the equipment box and hands them out to the other members of his group. Dale has his field book on the dock box. He, alone, leans over to read through the instructions for testing the pH of the water. The other members of his group put on goggles and then observe Dale as he reads.))
>
> ((After reading, Dale crouches down of the water bucket and equipment box, ready to complete the tasks for determining the pH of the water. Dale leads the completion of the task and the testing procedures.))
>
> ((Video is inaudible due to high wind. However, there is not much talk as Dale completes the task and the girls observe. Dale primarily handles the equipment for the pH test. He uses the dropper to place what he perceives to be the exact

amount of water into the test tube, up to the measurement line. The 3 girls in the group observe.))

Dale: 8 drops ((leans over to read the field manual)), it says…[??] with red indicator drops. ((To Ella)) Do you have the red indicator? ((Ella adds the appropriate number of drops to the water sample. Dale puts his finger over the top of the tube and then leans over to read the next instructions in the field book.))

Dale: Capture test tube and invert. ((Dale holds his finger over the top of the tube and inverts it to mix the sample and the reactant.))

Dale: Place tube in the black- ((Dale places the test tube in the kit with the color comparison chart. Ella holds the kit as Dale places the tube in to the opening.)) Okay.

((When the color does not change, Ella realizes that they used the wrong solution and holds up the correct bottle containing the reactant solution for Dale to see. The girls laugh.))

Dale: Okay. [??]. ((Dale has taken the kit and reactant and is working alone to complete the pH test, without the help of the girls in his group. All three girls observe as he completes the test.))

Ella: Haven't the drops turned red?

Gia: Yeah.

Kenzie: Oh:::h. ((This time, the water sample changes to a shade of red/pink.))

Gia: Now you have to put it upside down, don't you? ((Gia refers to the field book which instructs students to invert the tube. Dale inverts the tube. Kenzie grabs the kit to use for the comparison. Dale attempts to take it out of her hand and then adds the solution to the kit for comparison.))

Kenzie: It is… ((Kenzie shows the kit to Dale to get a reading.))

Dale: 6. ((Dale turns around to record the pH measurement in the field book. All 3 girls now look at the kit to determine the pH. One of the girl's states what she believes the pH reading is.))

Dale: Oh, that's the top?

Ella: Yeah.

Dale: Umm…I think it's closer to a darker red. I think it's 8.2 as well. ((Kenzie reaches to take back the pH kit. Dale holds on to it and continues to observe to get a pH reading.))

Kenzie: That's what I just said.

Dale: Maybe even 8 point (·) 4.

Kenzie: Umm, uh, that's what I was thinking but I, it was probably-

((Dale hands the kit to Gia to look. He turns around to the dock box to record their pH reading in the field book. Gia passes the kit to each of the other 2 girls to get their opinions again on the new reading.))

Dale: pH scale. ((Dale determines where to write the data and then records their pH reading)).

From the dialogue that transpired during this activity, I argue that Dale sought to control the activities during the beginning of the science camp program. Dale completed most of the procedures and for the most part, did not include the other group members. The other participants observed while Dale conducted each of the procedural steps for determining the pH of the sample. When Kenzie motions to help with reading the color chart, Dale resisted her efforts and failed to give her the kit. Later, the girls attempted to read the color chart and offered their opinions regarding the pH reading. However, Dale had already recorded his data in their field book rather than engaging in a discussion with the group as to the appropriate pH reading. The group moved on to complete two more pH trials and in each case, Dale repeated these behaviors. In this episode, Dale wanted to control all aspects of the activity. In essence, he was working individually even though he was in a group setting.

As the cruise transpired, Dale seemed to shift his attempts to take control of the activities. Dale noted in his post-camp interview that he realized he could not complete all of the tasks himself. Dale made this comment about the science camp activities,

> Because I couldn't do all the tasks at one time. There's a lot to, to the experiments. So I would say they more, I would say, I calmed down, I would say. And, I relaxed and I looked to trust the other group members, because,

um, they're (·) obviously they're capable as well. (post-camp focus interview, May 2010)

The science camp activities necessitated a realization for Dale that he could not take control of all the procedures and still have time to finish the activities. Dale started to feel okay with this as he conversed with his peers and learned to trust their opinions and actions. The beginning of this shift, for Dale, seemed to start on the research cruise. As Dale explained,

> The experience that really helped me was the boat trip. Cause that was the first exp-, the first, um, lab of the (·) camp, and I, that was a, defining moment where I could of (·) gone my (·) uptight, independent ways, or, with my group members. And that experience, (door bangs open) alright. I let my group members…help out as well and I wasn't (·) all…power -seeking]. (post-camp focus interview, May 2010.

I also noticed this change for Dale on the research cruise. In my field notes for that day, I wrote about a particular instance where Dale started to try and take control but then hesitated and reconsidered.

> One of the girls takes the bottle and starts to empty the water sample in to a bucket. Dale motions and moves in as though he is going to take over. He hesitates and then moves back to his original location. He seems uncomfortable that someone else is handling the water and has the impulse to take over, but then appears to change his mind. (Research cruise field notes, May 2010)

Dale began to make an effort to relinquish control, although it appeared for him to be a difficult process. As Dale gave up control and learned to rely on his group members, he started developing with regard to his collaboration skills.

Dale's development in communicating with his peers seemed to be influenced by several aspects of the science camp program. Dale commented that he felt more relaxed in this setting. He suggested that he was able to interact with his classmates on a personal level and make friends, an aspect of the camp that helped him to feel more comfortable. He further suggested that the lack of grading pressure helped him to feel relaxed in this setting. Dale indicated that he was no longer meticulous and controlling about his work because there was no pressure to have the experiments and activities work perfectly. He also believed that the authentic experiments influenced his development. In the interview, Dale stated,

> And, I really enjoyed, I didn't think I liked experiments, but some of these experiments, I had no idea what to expect. Sometimes there's experiments where you know what's happening, what's going to happen. But I had no idea what the pH levels were going to be or the salinity level (post-camp focus interview).

Dale was referring to the recipe-like experiments that can be common in science classroom settings. These pre-determined labs, coupled with grading pressures, made Dale anxious to get the correct answer and ensure that his experiments resulted in the intended outcomes. Dale appreciated the authentic science activities with which he engaged in at the science camp setting. He further highlighted this idea when he stated,

> And not, it didn't have to be *perfect*, because, in these experiments, it couldn't be perfect. You just have to, deal with what was going on and problem-solve. And, the relaxation helped me have a better result than if I was a perfectionist. Cause if, when, if I made one mistake, I would freak out. And, the relaxation, I was able to stay calm (post-camp focus interview, May 2010).

The combination of the authentic experiments and the lack of grading pressure helped Dale's identity development as a learner of science, specifically helping him to learn communication skills with his peers. The personal interactions and conversations afforded by the science camp setting helped Dale to feel relaxed and as such, he was more accepting of his peer's input during group work.

The comments made by Mr. Malone at the conclusion of the camp further corroborated this assertion. Mr. Malone suggested that the group activities with peers helped to shape Dale's identity as a learner of science. Mr. Malone commented, "he had to work with so many people" which helped Dale to develop his communication skills (post-camp teacher interview, May 2010). The classroom teacher believed Dale was less pressured in this setting which helped him to communicate his personality more, rather than just his knowledge of science. Mr. Malone stated,

> Um, no, like I said, I think he was able let his personality, personality out a lot more, um, then I've seen all year with him. Um, which is kind of neat to see. I saw uh, not a different side of Dale, but actually a whole Dale. Um, as opposed to just an academic Dale (post-camp teacher interview, May 2010).

Mr. Malone believed that Dale was more relaxed without the pressure of grades which resulted in his increased comfort in accepting input from his peers.

In Dale's case, conversation played a role in his development as a learner of science. At the science camp setting, Dale was able to participate in conversations with his friends which helped him to feel less pressured and competitive in this environment. This relaxation, coupled with the lack of grading pressure, influenced Dale's communication skills. He learned to collaborate with his peers and gain their feedback, rather than relying exclusively on his own ideas. Dale indicated that in the classroom setting they often did not have opportunities to work in groups. In the science camp setting, Dale had opportunities to work in groups with his peers. Through learning conversations that developed through such group work, Dale learned to see his peers as also capable of learning science. This resulted in Dale developing his communication with others, an important skill for participating in science.

Dale's view of science changed throughout the science camp program. Initially, he viewed science learning from the perspective of school science. Using this a lens, he saw success in science as memorizing science facts, answers the teachers questions correctly, and performing on classroom projects and tests. Because of this view, he saw himself as advanced in science and superior to his classmates. Thus, fellow classmates were not as competent which resulted in Dale relying on himself and his answers during group activities. The influential features of the informal science education camp created a new figured world of science for Dale, one in which his view of science was altered. He no longer saw science as about memorizing tests. With his new vision of science, he came to see others as also capable of science learning. This new realization helped Dale to communicate and collaborate with his peers. He came to see others as valuable contributors to the collaboration process.

Summary. Dale came to the MSC science camp program as a learner who enjoyed science and had confidence in his abilities as a learner of science. His classroom science teacher, Mr. Malone, indicated that Dale was highly motivated to learn science and was driven both by grades as well as his thirst for knowledge. Dale believed he was successful in science and hoped to pursue a career in health science. Through the science camp program, Dale had opportunities to work in collaborative groups with his peers. This opportunity, according to Dale, helped him to develop skills for collaborating with and relying on his peers. In his new view of science learning, he came to see others as capable and valuable contributors. Dale attributed the lack of grading pressure and competition to his relaxation at the science camp. As he became more relaxed, he felt more comfortable in seeking input from his peers and in showing more of his personality. He also developed a new interest in marine science. After the science camp program, Dale maintained his confidence in his abilities as a science learner. He developed skills in collaboration and still was considering a career in science.

Emma: "I feel more enthusiastic about science"

Emma was a white female that attended the MSC science camp program as a 7th grade student from Thomas Jefferson middle school. Emma was enrolled in a pre-advanced placement life science course in her school which was selected for the field trip. As Emma climbed off of her school's bus as they pulled in to the MSC campus, she towered above many of her male and female peers. She often wore t-shirts and sweatshirts which indicated she participated on her school's track and field team and played soccer. During the science camp, Emma was often observed playing with her hair or biting her nails. She was fairly soft-spoken, but was not hesitant about engaging in the group learning conversations. Emma had a calm demeanor and seemed mature compared to her high-energy classmates.

In some respects, Emma began the informal science education with a developed identity as a learner of science. She expressed interest in learning science, had confidence in her abilities as a learner of science and was considering a career in science as one option. At the pre-camp focus interview, Emma expressed an interest in learning about science. She indicated that the questions that she asked in the science classroom substantiated this interest. Emma suggested this idea when she stated, “usually the people that ask questions are the ones who, are actually interested in what they’re learning” (pre-camp focus interview, May 2010). Later in the interview, Emma added on to this notion and suggested that she and her peer, Jordan, dominated the questioning in their class. Emma asserted that the questions they asked were more in-depth which necessitated additional research for their teacher to respond to their questions. Emma spoke to this idea when she stated,

> With [Jo-], when [Jordan] and I were partners, we were once, (clears her throat), we would always ask all the questions, even if it wasn’t exactly related with what she was talking about. So, um, Ms. Tanner, she had to engage, and sometimes she would go research it and give me, the answer the next day. And so we’re the ones asking all the questions in our class. That’s pretty cool. (pre-camp focus interview, May 2010)

Emma positioned herself as a learner who was interested in science which she felt was evidenced in her ability to ask in-depth questions frequently in the science classroom.

Emma’s classroom science teacher, in referring to Emma’s identity as a learner of science, mentioned this questioning in the classroom. Ms. Tanner discussed Emma’s questions when she commented,

> Um, she’s also really active in the, the discussions. Um, to the point that a lot of times when her hand goes up, I have this, this, (laughs) almost fear of what she’s going to ask, because her questions are so, (•) um, (•) sometimes (•) intelligent, that, I’m not sure I got the answer for her. And, I mean, there have been multiple times, and I’ve taught (•) life science for 19 years, and, and pretty much have been able to answer almost every kid’s questions, but when Emma asks a question, I almost feel that little anxiety go up as though, “oh no, am I going to know the answer? Am I going to know the answer?” because

she really (•) she can come up with some ↑good ones. (pre-camp teacher interview, May 2010)

In her next comment, Ms. Tanner added,

> …awesome, yeah, awesome questions that I've even, you know, I, I say, you know, 'here's, here's my best answer to that, but I'm not sure. Let me look it up.' And then, I've emailed the AP teacher at the high school (•) she's not been able to answer some of the questions. And she's actually had to do research and get, get an answer back to me. So, she truly has the ability to think, beyond her age. I mean she, she really is um, (•) in, in a way just, the ability to, to apply stuff that, as many times as like I'd said, I've taught it, she'll see it from a different perspective than I'll being seeing it. 'I've never thought of it that way, I've never looked at it from that perspective.' (pre-camp teacher interview, May 2010)

Ms. Tanner offered this comment to point out Emma's ability to think about the science topics in new ways and apply what she has learned in the classroom. Ms. Tanner indicated that Emma was "very intelligent when it comes to applying what she knows" and that she was "gifted" in her ability to see things in a different way. This ability, in Ms. Tanner's opinion, showed Emma's curiosity in science and application of science (pre-camp teacher interview, May 2010).

I observed examples of Emma's questioning during the science camp program. As the MSC educators were providing science content, Emma would listen and sometimes ask questions that illustrated she was attempting to think further and apply the content that was taught. Margot provided a fact during the organism lab lecture in which she described the sunfish, which is the largest species of bony fish, and explained that it is a type of plankton. Plankton is defined as any organism that cannot swim against the current. Margot provided this example to emphasize that not all plankton species are microscopic. Shortly after providing this example, Emma engaged in a conversation with Margot in which she questioned the accuracy of this statement. Emma explained that she had visited the Monterrey Bay aquarium and viewed a sunfish swimming in its aquarium (Organism lab field notes, May 2010). She questioned why the sunfish was considered a plankton if she observed it swimming. This comment exemplified Emma's questioning and application of the content to the real-world. Rather than accept Margot's fact at face value, Emma reflected on the information and provided an example to counter Margot's claim.

A similar instance took place later during the organism lab. The participants had visited Tom's Cove on Assateague Island earlier in the day for the intertidal field experience. On that trip, Margot had explained that the mud snails in the intertidal zone move up and down the marsh grass with the tides. When high tide comes in, the snails move up the grass and then descend back down again during low tide. Margot mentioned that scientific research suggested that if a snail from the Atlantic coast is transplanted to the Pacific coast, it will continue to migrate up and down the grass on the Atlantic coast tide schedule. As the group was discussing snails during the organism lab, Emma raised her hand to ask Margot a question. Emma asked if the snails were born and raised in a lab, without being in the environment, would they know to follow an Atlantic or Pacific tidal cycle (Organism lab field notes, May 2010). This example from the organism lab further highlighted Emma's application of the science content. Emma demonstrated that she reflected on the information and attempted to apply it in new ways. Her willingness to ask questions exemplified her interests and abilities as a learner of science. The frequency of Emma asking such questions throughout the program suggested that this was an aspect of her identity as a learner of science who was maintained by the informal science education camp.

Emma and Ms. Tanner both indicated that Emma had confidence in her abilities as a learner of science. Emma believed that in general, she was an intelligent person. In her journal, she wrote about her interest in doodling. She wrote, “I doodle during class, yet I still get all As (Bs in math). My S. S. [social studies] teacher says doodling is the highest level of thinking, so I enjoy drawing so I don’t hold back. (my notes are covered with random stuff)” (Day 1 journal entry, May 2010). Emma used her writing in the journal entry to position herself as someone that might be considered a high level thinker as evidenced by her frequent doodles. Emma also wrote in her journal,

> I enjoy science, for me, it’s easy. I ask questions, I rarely study because I pay attention in class, and I get good grades because I enjoy it and its easy…I am confident, I pay attention so I usually know what I’m doing, I take in information (usually) without constant study (Day 1 journal entry, May 2010).

This additional statement from Emma shows that she though science came easily to her which resulted in good grades. Twice, she mentioned that she does not have to study often to do well in science. In Emma’s view, the fact that she did not have to study demonstrated that science was an easy topic for her to learn.

Ms. Tanner echoed this view of Emma’s confidence. She saw Emma as confident in her abilities as a learner of science. When asked if Emma had confidence in her abilities as a learner of science, Ms. Tanner described,

> In a sense, confident, but at the same time, um, not over confident. I mean, she doesn’t, she doesn’t ask those questions to be a smart-aleck, as some kids would. Um, I, I think she asks because she really wants to know. Um, so I

think, you know, (•) that is, is a good indication that, you know, she, she truly has that intrinsic desire to, to want to work. (pre-camp teacher interview, May 2010)

I asked Ms. Tanner what evidence she had to suggest Emma was confident in her abilities as a learner of science. To this question, Ms. Tanner responded,

> …she takes on leadership roles, she'll, you know, she'll jump right in and (•) um, lead discussions or (•) at times when, you know, and, and, again at other times she'll sit back, and let somebody else do that and, and she's, she's a pretty good team player too. But, she's a little more outspoken than [Jordan]. If, if it comes down to a battle, I see [Emma's] going to win the battle. [Jordan's] more meek. Um, [Emma's] a little, probably more confident in her approach to things (•) than, than [Jordan] would be. (pre-camp teacher interview, May 2010)

From Ms. Tanner's responses to the interview questions, it appeared to me that Emma came to the science camp program already identifying as a confident learner of science. Emma indicated her confidence as did the classroom science teacher. Ms. Tanner stated that Emma participated often in the classroom and took on leadership roles. This led her to see Emma as a confident learner of science.

Emma expressed a preliminary interest in pursuing science as a career during the pre-camp interview. She indicated that it was one option that she was considering, but she recognized that there were other fields she could pursue as well. When specifically asked if she would pursue a career in science, she responded,

> I might (•) career, uh, pursue a career in (•) marine biology or something to do with animals. But, what (•) I've been looking at now, (clears throat) like through a volunteer, just for, um, like summer thing. Hopefully, I won't have

> to often, but, I'd like to be one of those people that go out and wash off the animals after an oil spills, on like the beach and stuff. I think that would be like a really fulfilling (•) volunteer job. And like, I saw the commercial for Dawn and washing off their tails. And it was like, 'oh, look how cute.' So, I think that would be really cool. I have so many options open to me now, so. (pre-camp focus interview, May 2010)

This statement during the pre-camp interview highlighted another aspect of Emma's initial identity as a learner of science. Prior to the science camp, Emma had developed enough of an interest in science that she was considering it as a potential career option. She stated that she might consider a career as a marine biologist or some type of job related to working with animals. More immediately, she had aspirations of volunteering to clean up the animals affected by the recent oil spill. She thought that such a volunteer option would be fulfilling and would offer a chance for her to work with "cute" animals.

For Emma, aspects of her identity were maintained throughout the science camp program. However, there were some changes with regard to her opinions about how others viewed her as a learner of science as well as her level of engagement in science activities. Emma's participation in learning conversations played a role in her identity development as a learner of science at the science camp program.

Like the earlier case participants, Brynn and Hannah, I observed Emma at times engage in learning conversations using everyday language. In what proceeds, I present three instances where Emma used everyday language during a learning conversation. I believe Emma's use of everyday language helped her to make sense of the science content. The sense making practices aided Emma in acquiring new science content which helped strengthen her identity as a learner of science. Emma associated having science content with being "smart" and capable in science.

The first example I provide was from the micro-organism lab. Early in the day, the participants used a plankton net to collect water samples. Back in the lab, they used the water samples to create slides which they viewed under the microscope. They were instructed by the MSC educator, Margot, to identify three different plankton and draw them in their field books. In the episode that follows, Emma and her partner, Maeve, used everyday language to describe the plankton they viewed in the microscope.

Emma: Alright. Are they cute?...Oh my god. It's so cool.

Maeve: I, if you look at the lens, you can see them swimming around the light.

Emma: OH!

Maeve: Turn it towards you.

Emma: They're so cute.

Maeve: Ok Emma. Go 'head and look.

Emma: AW:::W.

Maeve: I don't know how you find them so quick.

Emma: They're they are. They are REALLY cute.

Maeve: They have like a tail on them.

Emma: STOP moving guys…*stop* moving. ((whispers))…What are those little circles?

Maeve: Yeah. It looks like [??]

Emma: This is so much easier to try and draw them ((She refers to Ms. Tanner's suggesting to view in the microscope with one eye while drawing with the other)). Alright, we have a little squiggly thing. It, it's like this. ((Emma motions with her hand and uses her pencil to demonstrate how she would draw the squiggle to represent what she is observing under the microscope.))… OH:::H. He's so cute. ((Emma stands up and then Maeve leans forward to look.))

Maeve: Yeah. ↑Oh, he is cute! Oh, I, get my first one. ((Maeve leans back from the microscope and starts to draw her first plankton in the field book. As Maeve draws, Emma looks back into the microscope.))

Emma: Do your last one and I'll start looking at this.

Maeve: Sure.

Emma: There's one but it just looks like this. ((Emma leans over and draws to show Maeve. Emma stands up again to talk to Margot.)) It's a blob. Little, dark blobs swimming around.

Margot: Those are blobs swimming around ((laughs at Emma's comment.))

Emma: I, I could draw, I didn't see any detail. It's just a shadow. ((Emma leans back over and views the microscope.))…EWW, I see the long ones! THIS IS A really long one that looks like this ((draws)). That, that's what it looks like. It's got a little lump in the middle. ((She goes back and forth between the microscope and her drawing. She adds more to the drawing after each look into the microscope.))

Maeve: It's [??]

Emma: Ew:::w.

Maeve: She said it's [??]

Emma: Wait, it's that circle again.

Maeve: [??]

Emma: Yeah. Look at it. Move it around. Eww. Alright, look, look, look. ((Maeve leans over and looks in the microscope.)) Don't you want to see it. It, it's that one long one.

Maeve: It's really long. It's moving really slowly.

Emma: I know, it's really long and it's really weird.

Maeve: It's got two circles at the top.

Emma: What? ((Emma leans over to look in the microscope again.))

Maeve: Look again. (•) It's like a circle, with a circle.

In this example, Emma used everyday terms to describe the plankton. Emma and Maeve used phrases such as, "he is cute," "they have like a tail on them," "long ones" and non-scientific terms such as “circles,” “blobs,” and “squiggles.” Emma also used gesturing to help her describe what she was viewing. The use of non-technical language and gesturing helped the participants to described the characteristics of the plankton and engage in a learning conversation even though they hadn’t yet learned the appropriate terminology. In using everyday language, Emma and Maeve were able to engage in a science learning conversation to describe the plankton species. Engagement in a science conversations helped the participants to see themselves as learners of science. Emma, in particular, indicated that knowing science content helped her to feel smart. She referred to this during the pre-camp interview and claimed, “it’s interesting to be able to go home, and tell your parents stuff, and know, like, what are you talking about. It’s like, yeah, I feel smart” (Pre-camp focus interview, May 2010). Everyday language seemed to serve as a bridge for Emma to make sense of and acquire new scientific knowledge. The new science content helped Emma to see herself as “smart.”

As a second example, I include an excerpt from the organism lab. Emma was working with her group to identify a fish using the dichotomous key. They come across several terms that they were uncertain of as they progressed through the key. In these instances, Emma used everyday language to help herself and her group members make sense of the term in a manner that helped the group continue working with the key.

> Ariel: Um, is it adipose=
>
> Maeve: =What’s the adipose?
>
> Ariel: ((Ariel turns and addresses Emma.)) What is adipose?
>
> Emma: Um, I think that adipose ((looks in the aquarium.)) Um, it’s this little bity fin before the caudal fin. ((Emma points into the aquarium to illustrate.))
>
> Ariel: Is there one?

Emma: Um no.

Ariel: Wait, yes it is. Look. ((Ariel points it out in their key.))

Maeve: That other little fish came out though.

Maeve: (Are we finished with one))?

Ariel: No, that says dorsal, I mean-

Emma: No, it's not. It's all one.

Maeve: Alright.

Ariel: Maybe.

Emma: Medium gills on each side of caudal peduncle.

Maeve: You have to [??] ((giggles.))

Ariel: What's a keel?

Emma: I don't know. Look it up.

Maeve: Look it up.

Ariel: This isn't a dictionary.

Emma: Alright, let's go. Medium keels on each side of adipose.

Ariel: There's nothing on here about the keels. Oh wait, a keel. Is the little-

Emma: Like, there's a line right there.

Ariel: (gasps) Eww, it's the little line that goes through it. A medium one. It has one.

In this episode, Emma used the phrase "little bity fin" to help herself and the other group members make sense of the scientific term, adipose fin. The adipose fin is a small, soft fin located at the back of the fish behind the caudal fin. Emma used everyday language to describe this fin which helped her group members locate the fin on the fish and understand the description in the dichotomous key. Later in the activity, the group had a question about a keel. The keel is also a part of the anatomy of some fish and describes a lateral ridge along the caudal peduncle (the back section of the fish). Emma referred to this as a "line" which her group members then noticed on the fish. This helped them recognize the feature on the fish that the description was referring to and they were able to make sense of the scientific term, keel. As the participants came across the technical terms and were able to make sense of these terms, they gained confidence and come to see themselves as learners of science.

The final example I present here was from Emma's activities on the intertidal field experience. While wading through the stream, Emma came across a type of green algae with the common name, sea lettuce. At this point, the participants had not yet learned about sea lettuce from the Margot. However, Emma and her group members noticed its characteristics and recognized that it was sea lettuce.

> Emma: ((Emma picks up a piece of sea lettuce floating in the water.)) Eww, it does feel like paper.
>
> ?: I told you.
>
> Emma: Eww. ((laughs.))
>
> Tessa: Eww, look at that.
>
> Emma: ((To Mr. Crawford)) Feel it.
>
> Mr. Crawford: It looks like lettuce. That's what it looks like.
>
> Maeve: Okay, come on Mallory. ((Mallory was leaning over looking at something in the water.))
>
> Emma: Here, you guys wanna like, write a note to somebody? ((holds up the lettuce and has it stretched out so her group members can see.))
>
> Mallory: It looks like lettuce, like plastic lettuce.

The girls used everyday terms such as "paper," "lettuce," and "plastic" to describe the characteristics of the algae. Later in the organism lab, they were able to use these features of the algae to correctly identify it as sea lettuce. The three examples I provided demonstrated the unique ways that everyday language was used during learning conversations. By using non-technical terms, Emma and her peers were able to engage in science conversations to make sense of the science content.

Although there were instances where language played an influential role in further developing Emma's identity as a learner of science, I also noticed times when Emma disengaged from the conversation. Specifically, this happened several times when adults were present and dominated the conversation and activities.

An example of the adults' influence occurred during the research cruise. Emma was working at the physical observation station with her group to measure water transparency using a secchi disk. Two chaperones, Mr. Crawford and Mrs. Rogers, worked with the group to complete the data collection. From the dialogue that surfaced, it appeared as though the chaperones were dominating the conversation and directing the activity.

> Mrs. Rogers: Do you want to read for everybody what we're going to do?
>
> Maeve: Sure.
>
> Mrs. Rogers: Okay.
>
> Maeve: Okay, let's see. Um, step number 1, place disk into the water. Step number 2, lower down until disk is barely visible. Number 3, hold Forel U-,ule over disk and water and compare color to known colors. Number 4, read and record. Number 5, umm…I guess says that=
>
> Mrs. Rogers: =is that the other side?
>
> Maeve: Yeah. Hang on. Visually find where the water is…((turns the page)) at the surface…where the water is touching the rim. Almost=
>
> Tessa: =But it's all still on this side.
>
> Mrs. Rogers: You're right. We're still on the secchi disk.
>
> Maeve: Yeah, this is all secchi still. Umm, number 6. Grab the line and easily (•) when easily reached will touch water. Number 7, read and record and then (•) repeat three times and then find the average. Take average, um, (•) transparency and divide by 2.7 feet and that's in the lab.

Mrs. Rogers: Okay.Who wants to start first with the-? We get to do it three times.

Mr. Crawford: ((Mallory, let's grab the line))

Mrs. Rogers: Alright Mallory. Your dad has volunteered you. Here you go. ((Mallory walks over to the side of the boat where Mrs. Rogers is standing.))

Mr. Crawford: Alright, you're gonna lower the, she, she'll read the directions out one more time ((motioning with his arm toward Maeve to indicate she will read again)) but as she does, each of you do what you're supposed to be doin'.

Maeve: Okay.

Mrs. Rogers: (It might be) helpful if you kinda come down on your knees a little. ((The girls in the group squat down as Mrs. Rogers demonstrates.))

Maeve: You place the disk in the water.

Mr. Crawford: Alright. And then I need somebody to hold this. ((Motions by extending the Forel Ule color kit out toward the group members. Tessa takes the kit from Mr. Crawford.)) Put it around your wrist. That's gotta be the colors that you look at. ((He points from the color kit to the water to help indicate the procedure for using the kit to compare to the color of the water.))

Maeve: ((reading from the field guide)) Alright, just lower it. Lower it down to where it is barely visible.

Mr. Crawford: ((to Mallory)) Remember, don't step on it.

Maeve: Put it down farther and then you bring it back up.

Mrs. Rogers: Get down on your knees too, Mallory.

Mr. Crawford: Yeah.

Mrs. Rogers: You might be [??]

Maeve: Don't fall off.

Mr. Crawford: Mallory. ((Mr. Crawford reprimands Mallory because she is pretending that she is going to fall and makes the group members laugh.)) You're steppin on it. ((He turns and directs his question to Maeve.)) Alright, what do you (do next)?

Tessa: (Barely visible.)

Maeve: ((Opens the field book)) Yeah.

Mr. Crawford: Until it's barely visible?

Tessa: So do it to where you can't see it at all, and then bring it up to where you can barely see it.

Mallory: Okay, it's up barely=

Mr. Crawford: =NO, Mallory, you. I got the wrong one. She wears glasses. ((Refers to Mallory and believes she can't see to properly complete the task because she is wearing glasses.)) You all, ya'll wear glasses?

Maeve: [I have contacts in.]

Emma: [I don't wear glasses.] I have contacts.

Mr. Crawford: Mallory, that's=

Mallory: =I can see this.=

Mr. Crawford: =That's visible…Here. ((To Mallory)) Right there. Alright. Gotta estimate where you think it's gonna be, bring it up.

Maeve: Okay, now you have to compare the colors.

Tessa: Yeah, something. How do we do that? ((The group is silent as Maeve reads in the field guide.))

Mrs. Rogers: Hold it over the water.

Mr. Crawford: Who has the Forel Ule thing?

Maeve: I do.

Mr. Crawford: You need to stand over it. ((Tessa stands up and takes the kit over to the side of the boat where Mallory is working with the color kit.)) Drop it back down,

Mallory. To where it was?

Mr. Crawford: ((To Tessa)) Color. Repeat, or, repeat two. ((Tessa leans over the boat and uses the Forel Ule kit to determine the color.)) Alright. It's got the colors or whatever matches that. ((There is a long pause as the girls attempt to determine the colors using the kit. The group members observe them as they do this while Maeve continues to read, periodically, in the field guide.))…Alright. You need to record.

Tessa: Yeah, then we gotta record it.

Maeve: [??]

Mr. Crawford: Yes I do.

Maeve: And I record the, ↑color?

Mallory: Do I bring it up now? ((Both Mr. Crawford and Mrs. Rogers stand over Maeve and watch Maeve as she records the group's data in her fieldbook.))

Maeve: Or transparency? Color.

Mallory: Yeah.

Emma: Transparency's like the-

Maeve: [??]

Mallory: I'll bring it up. I think what you'll, [??] ((Mallory walks over to the side of the boat to lift the secchi disk back on to the boat. Mr. Crawford walks over with her as well and grabs the rope as Mallory brings up the disk.))

Mr. Crawford: Right there, yeah. Try and bring it up. She said that was a half a meter.

Mallory: Yeah.

Mr. Crawford: This'd be one meter. So how=

Mallory: =So:::o … we want 85.

Mr. Crawford: centimeters…Um:::m, yeah and about 90-85.

Mallory: Yeah.

Mr. Crawford: Whatever y'all think.

Maeve: 90 or 85?

Mallory: 85.

Maeve: Yeah. ((Records the data in her field book.))

Mrs. Rogers: Good job.

In this example, both of the adult chaperones dominated the conversation and activity. They directed the procedures and talked often in the conversation. Ella participated infrequently in this conversation; she offered input only twice throughout the segment.

As a contrasting example, I present an activity that Emma engaged in later on the cruise. Emma and her group were working without the adults at the water quality station. In this example, I argue that there was a contrast between the groups interaction when they worked alone with when they worked in the presence of the adults.

> Emma: What are we supposed to do for salinity? Do you put the drop thing in for, the drops? ((She grabs the container holding the refractometer.))
>
> Mallory: Salinity and density is the refractometer.
>
> Emma: Yeah. ((Tessa sits up and leans over Emma to make sure she has the correct piece of equipment.)) Oh, there it is. ((Tessa grabs another container. Emma unscrews the top of her container and removes the refractometer from its casing.)) Where do we...(do I pour it on there?)
>
> Mallory: I don't know. ((laughs.))
>
> [?]: Don't you drop it on that and then close the lid, isn't that what you do?
>
> Tessa: (Okay, first let's rinse it.) ((She grabs the rinse and motions toward Emma to clean the lens of the refractometer.))
>
> Emma: Okay. Where do we rinse it at? ((Tessa sits up and kneels. Emma flips up the lens on the refractometer for Tessa to rinse it.))…Do we pour it on there?
>
> Tessa: I don't know. ((laughs))
>
> Maeve: Why don't you drop it on that and then close the lid and splash it around.
>
> Tessa: Yeah. ((She turns back to Emma and drops the saline on the refractometer lens.))
>
> ?: It cleans it, that's how we get it clean. ((Tessa drops water on the lens and then Emma dumps the water off of the refractometer lens into the waste bucket.))
>
> Emma: K. What (do we do next)?
>
> Maeve: Put a few drops on that, right?
>
> Mallory: Rinse the lens with freshwater and then place water sample on lens. ((Emma grabs the dropper of water and motions to Tessa to help her with the

procedures. Tessa is leaning forward and replacing the rinse water into the equipment bucket.))

Emma: We don’t need that. ((She refers to the rinse water as Tessa replaces it in the equipment bucket. Tessa takes the dropper.))

Tessa: Do we have to repeat this? ((Tessa leans over to the bucket containing their water sample and reaches in with the dropper to collect water to place on the refractometer. The rest of the group members observe as she does this. Emma flips off the lens cap so that Tessa can place drops of their sample on the lens of the refractometer.))

Mallory: ON LENS.

Tessa: ↑I did.

Mallory: Oh. ((laughs))…Wait, it. What’s it-

Emma: Oh, it’s, the water was already off of it.

Tessa: Okay, it’s- ((The drops have been placed on the lens so Emma closes the lens cap and holds the refractometer up to the light to get a reading.))

Emma: Now what?

Tessa: Okay. So now read it.

Mallory: Close the lens and then read and record.

Emma: It’s uh.

Mallory: What is it?

Emma: Oo-kay...it’s really hard to see the line.

Tessa: Want me to try it?

Emma: Want to?

Tessa: Yeah.

Mallory: Is this like team 1, team 2, team 3, team 4?

Tessa: ((Tessa reaches over and uses the dropper to get more water from the collected sample.)) Okay.

Mallory: Now, this is the salinity? ((Tessa adds more drops of water to the refractometer lens. After more water has been added, Emma closes the lens cap and holds up the refractometer again to get a reading.))

Emma: Um:::m...thirty (•) five p-p-ts.

Tessa: 35 parts per thousand?

Emma: Umm-hmm. 35.

Tessa: 35.

Mallory: 35 for what?

Tessa: P-P-T.

Mallory: (laughs).

Tessa: That’s salinity.

Emma: K. It’s still, the line just got clear.

Mallory: Alright.

Emma: one point zero, wait, two five. ((Emma is now reading the line in the refractometer viewfinder for density.))

Tessa: (to Mallory) 1.025

I argue that the adults influenced and in some ways, shut off the conversation. However, in the peer-peer conversation at the water quality station, the participants engaged in discussions to negotiate the correct procedures for completing a data collection task. They debated with one another to consider the appropriate data readings and recordings. On the other hand, during the adult-learner conversation, the adults told the students what to do and assigned participants various tasks. There was less of a need for the participants to converse with one another to negotiate the tasks and data readings on their own. During other peer-peer conversations I observed with this group, the participants looked as if they were having fun as they laughed, giggled and joked with one another while completing the learning tasks. However, with the adults present, they were more serious and interacted less playfully with one another. Specifically for Emma, she participated more often in the conversation with her peers. When adults participated in ways where they exerted influence and power, there were less opportunities for productive conversations between participants. In this way, the conversations may not have positively influenced Emma's identity as learners of science.

After the science camp program, many aspects of Emma's identity as a learner of science were reinforced. Emma maintained an interest in science and still had confidence in her abilities as a learner of science. Emma suggested that the science camp program helped to augment her enthusiasm and attitude toward science learning. Emma commented on the affective dimensions of the camp in her journal entries. On day two, she wrote,

> Today was really fun and educational. I had a great time. Yes, today I feel more enthusiastic about science. And the things we did were hands-on, so they're going to stick. Yes, here we have more fun with friends, and we're up close and personal. I feel more confident about asking questions because they see me as a good learner. (Day 2 journal entry, May 2010).

The next day, she reflected,

> Today was really fun. I learned a lot. Nothing has really changed except I have a bunch of new, fun memories. In camp with friends, we're allowed to get souveniers, talk and have more freedom making learning easier. It didn't really change how I think about myself in science, but it was awesome. (Day 3 journal entry, May 2010)

In her final journal entry, she noted, "I am more enthusiastic about science and have been introduced to many new ideas which I am eager to learn more about. I have a more positive attitude about science because of all the fun I had" (Day 4 journal entry, May 2010). Emma attributed this increased enthusiasm and positive attitude to the focus on fun at the science camp, the novelty of the science camp as well as the opportunity to learn science in the field. The authentic activities and opportunities for working with her friends, for Emma, were influential on her enthusiasm and attitude. She indicated that the novel and hands-on aspects of the science camp was more interesting which helped her to engage in the subject.

> During the post-camp focus interview, Emma commented, “Just, I know more. So, it’s, I like that. It’s pretty cool. It’s just way more interesting, I guess. Yeah. But, not, it’s not the same as going out and actually doing it. Because at school you’re just in a classroom, and, like, working on a worksheet. It’s not the same as actually going out and getting’ the net. Getting up close with everything. (post-camp focus interview, May 2010)

As the interview continued, Emma brought up this notion up again,

> Um, (•) it’s, way cooler to, more, just different, to be able to go and do that. And…at school we already learned about how the bogs and the marshes and the swamps and all that are really important. And then it made me really want to go out and see it by itself and seeing the different areas and zones, all the different plants and stuff. That’s gonna stick and so we really have gotten to think about that later. (post-camp focus interview, May 2010)

Emma reiterated this idea of the science content “sticking.” For Emma, the opportunity to participate in science hands-on and in the field would be more memorable and would help her learn the content more easily. In this sense, she would remember the content better and it would “stick.”

Emma talked specifically about the activities that helped the content to “stick.” She commented during the post-camp interview,

> The experience of doing something for the first time, it will stick, especially like, jumping in the marsh or looking at the sea cucumbers. My friend, she got

> to hold it. So, she’s gonna remember that but she’s also, and I’m also going to remember everything else that we learned about that area, because, that was a highlight, but, you still (•) took in everything and you’re more enthusiastic, so you’re paying more attention. And, also, the lectures, especially the first one, everybody was falling asleep. Everyone’s just like, “oh my gosh, let’s get out of here” because we’d just gotten off the bus and we were all really impatient and all had something we wanted to do. And then, (•) that was like the most boring part. (post-camp focus interview, May 2010)

In this statement, Emma set up a contrast. She suggested that the field-based activities of the science camp were a highlight and would help her remember the content that she learned. On the other hand, she found the lectures boring and less engaging. For Emma, these activities at the camp were less influential on the affective dimensions of her identity as a learner of science.

Additionally, the learning activities at the science camp helped Emma to feel more comfortable participating. Emma credited this comfort to the hands-on activities as well as the occasion to work in groups with her friends. Emma pointed this out when she explained,

> I feel more comfortable participating, especially after catching the fish in the canal and stuff. Cause, everybody was working together and we’re all friends and I remember having fun, especially the guides and stuff. So, I feel more confident now.
>
> Everybody’s experiencing together and opens everybody’s first time. So, if you make mistakes, then, you’re not, like, picked out for it. (post-camp focus interview, May 2010)

Emma felt that working with her peers and friends helped her to feel more comfortable because there was shared accountability. She stated that if a mistake was made she was not, “picked out for it.” She added that working with her friends made her feel comfortable because they could ask questions or help to explain difficult topics. In her interview, she commented,

> When we ask questions, then, the person doesn’t want to ask the question, the friend will ask it for them and then, if something’s boring then (•) you’ll sit and giggle about it but then you’re actually paying attention because you’re away and you’re thinking about what they’re saying for it to be funny. And, then, they’ll encourage you if you don’t understand something, then they’ll maybe explain it to you and just help you out, like on what could happen. (post-camp focus interview, May 2010)

In Emma’s view, she was able to feel more comfortable because responsibilities were spread throughout the group and with the conversations, her peers could help explain a topic when it was unclear. Emma suggested that a friend could also ask a question when another group member felt uncomfortable doing so. I speculate that Emma’s comfort came from her concern about how her teacher would see her as a learner of science. Emma may have believed that by asking questions or expressing that a topic was unclear, the teacher may think differently of her as a learner of science. It is possible that Emma felt more comfortable in the group because she did not have to be concerned with how her teacher viewed her as a learner of science when the responsibilities and expertise were distributed throughout the group.

Another way in which Emma’s identity as a learner of science was influenced by the science camp program was with regard to how she perceived that others viewed her. Emma believed that working with her peers and conversing with them during the hands-on science activities helped others to see more of her personality. She perceived that others might view her as a book learner and a quiet person. Emma explained,

> You'll just be able, um, Emma, just be able to do whatever and just have fun with it. It's not (•) as (•) labeling, I guess. Like, (•) we're not just labeled, "you're the person that's always reading the book" and then, "you're the person that never does anything, you're areally boring person and you don't like science." Now everyone is, knows each other better, so we have a wider range of how we think about each other…Well because now that we've got to know each other, we've seen each other's, like, habits and stuff and what we do with our free time. We've had time, had time to just sit and talk. So, we're not just a person in the classroom in the corner, asking questions. We're the person, who like, tells jokes and all that kinda stuff. And, the person who will get down and dirty.
>
> like, a wider range person. So, it's a variety. (post-camp focus interview, May 2010)

Emma perceived that in the science classroom, others viewed her as "the person that's always reading the book," "a person in the classroom in the corner, asking questions," and "boring" By engaging in conversations and talking with her peers at the science camp, others came to see a different or "wider" view of one another. The participants learned more about each other which Emma speculated may have helped others to see another side of her personality, one in which she tells joke and is willing to participate in the activities, to "get down and dirty" (post-camp focus interview, May 2010). As the interview continued, Emma added,

> I think that with everybody's experienced with each other and doing it for the first time with each other, that everybody's gotten closer and so everybody sees each other, as, well they know each other better, much better friends.

In this statement, Emma further explained her view. She saw the science camp as an opportunity to engage with her peers. As they conversed with each other, they learned more about their peers which influenced their views of one another. For Emma, others had a chance to learn more about her which influenced their view of Emma as a learner.

A final way that the science camp influenced Emma's identity as a learner of science was related to her career choices. At the beginning of the camp, Emma expressed an interest in science as a potential career choice although she stated that it was just one option she was considering. After the science camp, she maintained this view but indicated that the science camp prompted her to consider her career options. Emma explained that the science camp gave her more knowledge about science careers. Emma stated,

> I think the camp experience really expanded my horizons, I guess. Because, for the career, I don't really know what am going to do in life yet. So, I can't really say. But, (•) it's given me more knowledge and more base for if I do want to pursue a science career. Like…So, I know more specific details and then, I know about all different kinds of science and all different types of stuff and I get to see people…Yeah. And then being able to go and see the people that did choose a science career, see what they do. That'd be pretty fun to be like Margot and being able to jump in and teach kids like about all this stuff. (post-camp focus interview, May 2010)

Emma asserted that the science camp gave her information about science careers. When I asked her to explain what she meant by “stuff,” she articulated that she was able to see different areas of science such as, “navigation, the animals and the environment, the ecosystems, the intertidal” (post-camp focus interview, May 2010). The science camp provided an opportunity for Emma to see more of what might be involved with a science career. Additionally, she saw Margot, the MSC educator, at work which helped her witness a science career in person.

Ms. Tanner, the classroom science teacher, added her ideas about the changes she observed in Emma over the course of the program. Ms. Tanner asserted that many aspects of Emma’s identity as a learner of science were sustained through the program (post-camp teacher interview, May 2010). She believed that Emma was still interested in science and maintained confidence in her abilities as a learner of science. One change that the teacher anticipated was Emma’s ability to apply the science information that she learned at the science camp to their learning in the science classroom. Ms. Tanner speculated that Emma was reflecting on the information and would be able to make connections to the life science content they were learning in school. Ms. Tanner commented,

> Um, I think, again when we get back, she’s going to be able to apply so much of what we’ve learned in, in school to the actual world, you know, and I think that’ s going to help her and I think that’s gonna, she’s gonna bring it back into the classroom for the other students. It’s not just she learned, but I think she’s gonna be able to reflect on it and then, when we talk about stuff, she, she will say, ‘remember when we did so and so?’ Or, ‘is this an example of what you’re talking about?’ (post-camp teacher interview, May 2010)

When I asked if this aspect of Emma's identity as a learner of science was different in the science camp setting than the classroom, her classroom science teacher added,

> Um, probably better because she'll, it'll be more application. You know, so much of class is, it's what I tell them and what I show them whereas here, they experienced it and I think…they did it and I think that's going to set better with her and she's gonna really be able to, to make it make sense. (post-camp teacher interview, May 2010)

Ms. Tanner's perspectives suggested that aspects of Emma's identity as a learner of science were maintained. However, she believed that the opportunity for Emma to experience the science content hands-on and in the field would help her in applying the information. Ms. Tanner contrasted this opportunity with learning in the classroom. At school, the learners were told and accepted the information from the science teacher. Rather than being told the information, the learners were able to experience the science information through hands-on activities and learning in the field during the science camp program (post-camp teacher interview, May 2010).

Summary. The case of Emma demonstrated that some of the science camp participants attended the program as learners that already identified as learners of science. Prior to her participation in the informal science education camp, Emma already enjoyed science, believed she was successful in science and was considering a science career as one of her options. The learning conversations that Emma engaged in at the science camp helped to sustain aspects of her identity as well as positively influence and support other aspects. In particular, participating in learning conversations with her peers helped others to learn more about Emma and see another side of her personality. Therefore, Emma's identity as a learner of science changed in terms of how she believed others saw her as a learner. She believed that her peers saw a "wider range" of her personality and came to see her as someone that was fun and not just a book learner. The conversations, in Emma's view, also helped her to feel more comfortable because she believed there was less of a focus on her as an individual. The responsibilities and expertise were distributed throughout the group which Emma described as helping to make her feel more comfortable. Generally, the conversations positively influenced Emma's identity as a learner of science. There were times when the conversations may have had less of an influence, specifically when adult chaperones were participants in the conversation. During these times, Emma talked infrequently and had fewer opportunities to engage in sense-making practices with her peers. These adult-learner conversations appeared to have less of an influence on Emma's identity as a learner of science.

Jordan: "Science rocks"

In several ways, Jordan's experiences at the informal science education camp paralleled Emma's experiences. Jordan began the science camp as a participant that identified in some ways as a learner of science. Over the course of the program, aspects of Jordan's identity as a learner of science were supported and maintained. Other aspects were positively influenced by the science camp and his identity as a learner of science developed further. The case of Jordan in particular demonstrated how the supportive environment of the science camp helped foster learner's participation and engagement in science learning activities.

Jordan was a white, male, 7^{th} grade student from Benjamin Franklin middle school when he attended the science camp field trip program at the MSC. Like Emma, he was a student in Ms. Tanner's pre-AP life science course. Jordan was still quite small and many of the females in his class as well as some of the males stood above him. With his freckled face and short, cropped hair cut, Jordan looked quite young compared to his fellow case participants, Emma and Celeste. Jordan was self-described as a "nerd." He was somewhat timid or as his classroom science teacher, Ms. Tanner, described him, "meek," at school. Jordan performed well in the science classroom but his classroom science teacher added that he had other interests in addition to academics. His classroom teacher saw Jordan as well-rounded, explaining that he was also an athlete on soccer teams and participated in his church's youth group. His mother was an elementary classroom teacher and attended the field trip as a parent chaperone.

Jordan began the science camp program as a learner who was interested and enthusiastic about learning science. In the pre-camp interview, he made the following statement: "Science rocks. ((Holds up a rocker sign with his hand))" (pre-camp focus interview, May 2010). Jordan found science more interesting than other subjects and stated,

> I just think, like, science is interesting, like, I like history and math is okay, but I think like science is like, it keeps you awake. Cause you like pay attention. It's like, this stuff's cool, like. It's not like in your other classes when you say something they're like, 'eww, gross.' It's like, 'oh wait we dissected a frog today.' It's just pretty cool. And, just, being able to, do stuff like that. And I think like, I want to pursue a science career, so. (pre-camp focus interview, May 2010)

I further prompted Jordan to explain this interest in science. I wanted to understand what he believed was particularly interesting about science relative to other subjects. He explained,

> I don't know. Just like…keeps me on the edge of my seat and I wanna, learn more. And I always think there's like, I wanna learn more, I wanna learn

> more, I wanna learn more. So. Like, we dissected a frog, I mean, I, I touched its heart and like, kinda, touched like everything, and the organs, but I just liked to say, "oh, I touched the frog's heart" and stuff like that. (pre-cam focus interview, May 2010)

Jordan's comments at the pre-camp interview indicated that he found science interesting. He believed the content of science was more engaging than what he learned in other school subjects such as math or history. Science kept him on the edge of his seat, especially when he engaged in hands-on activities such as dissecting a frog. The topic of science motivated him and kept him "awake" and he was able to "pay attention" (pre-camp focus interview, May 2010).

Another aspect of Jordan's identity as a learner of science who was already developed prior to starting the science camp was his view of science. Jordan did not view science as a subject just for school but rather saw that it was important in everyday life. He was able to articulate several examples of science used in everyday life. He suggested that science helped explain "commonsense" ideas such as the fact that oil is flammable. Jordan commented, "Just like (•) some concept, like the oil's flammable, just some common sense stuff. They, like, you can probably figure out otherwise, but in science, you learn about it" (pre-camp focus interview, May 2010). This fact, according to Jordan, was determined through science and helped to characterize oil as flammable. Another example Jordan provided was sunburn. When asked how science was important in everyday life, he explained, "Um, like, as you can probably see I got sun burnt. And, I probably, if I would have, paid attention, I would have, you know, not gotten sun burnt" (pre-camp focus interview, May 2010). Jordan speculated that science helped us to understand health concerns such as sun burn. Scientific research has suggested ways to prevent sun burn. Jordan indicated that if he had paid attention to this research, he could have avoided getting sunburned.

As a final example, Jordan explained how science in everyday life was used to construct the Chesapeake Bay Bridge-Tunnel. The Chesapeake Bay Bridge-Tunnel is a series of bridges and tunnels that descend below the bay floor. The tunnel extends for approximately twenty miles and connects southern Virginia to the Eastern Shore. The bridge is considered one of the seven modern engineering wonders of the world. Jordan realized that the construction of this bridge involved science and engineering and was an example of the everyday use of science. He stated,

> I think that, like so far, I, even so far, just traveling here, was a lot of like, science, cause when you think about it, about how much work went through, like the Chesapeake Bay Bridge Tunnel and stuff like that. I thought that was pretty cool, going, that was the first time I've been underwater in a tunnel. (pre-camp focus interview, May 2010)

These examples that Jordan provided suggested to me that his identity as a learner of science included a view of science in everyday life. He did not see science as a subject confined to school but rather saw science as important in everyday life. Jordan was able to provide examples of the importance of science to everyday life to understand that oil is flammable, to prevent health issues such as sunburn, and to construct bridges such as the Chesapeake Bay Bridge Tunnel.

Jordan had confidence in his abilities as a learner of science. When specifically prompted to speak to his confidence during the interview, Jordan commented, "I think I'm really good, in science" and later added, "I mean, I've always been, the over-achiever of my class" (pre-camp focus interview, May 2010). He reflected about his abilities as a learner of science in his journal entry as well. On the first day of the science camp, he wrote, “Science and math have always been my strengths. In a way I guess they’re interconnected. Science is so easy for me to learn” (Day 1 journal entry, May 2010). These comments from the interview and journal exemplify that Jordan believed he was good at science and saw it as one of his strengths.

Jordan’s classroom science teacher also spoke to his confidence as a learner of science. She believed he had confidence, but qualified it as a “surface confidence” (post-camp teacher interview, May 2010). Ms. Tanner offered the following observation,

> [He is] Probably not as confident, um, as he comes across. I, I think he is…less confident than what the other students see. Um…but at the same time, I think he realizes he does have good ideas. You know, as, as a leader, he’ll take a leadership role. Um, but he’s also willing to give that role to someone else if, if they have other ideas. He’s a good team player. (pre-camp focus interview, May 2010)

I asked Ms. Tanner to expand on this thought to which she responded,

> There are times that if somebody challenges his idea, that he, he doesn’t shut down, but it’s, he’ll take a step back to look at it. And, and maybe not be as, as overconfident as sometimes he appears. I think some of the other kids are somewhat intimidated because he does seem to know. I think he will step back sometimes and (•) like “okay,” you know, or maybe just doesn’t think he could (•) take it (•) to that point that he could convince them otherwise. (pre-camp focus interview, May 2010)

Ms. Tanner’s perspective suggested that Jordan did have confidence in his abilities but that it was an area of his identity as a learner of science who could be strengthened. She noted that in the classroom, Jordan at times backed down from conversations, perhaps because he was uncertain that he could convince his peers of his argument. She believed that this uncertainty might reflect an area where he still lacked confidence.

When I asked Ms. Tanner for her perspective of Jordan's identity as a learner of science, she described him in the following way,

> As a sponge, you know? Anything we say, he seems to just soak it up, and then, like I said, to be able to take it to the next level, to really be able to apply it. Um, he seems confident (•) in his ability (•) um, not intimidated by new information. He takes it, you know, and like I said, he tries to apply it, which is, which is great…just, whenever we do, you know, class discussions or projects, he, he takes what we're saying and, and then, you know, can, can kinda summarize it, you know? He'll turn it back around and, and put it into, um, you know, 'are you saying this?' Or, um, just, just the ways he views things sometimes, you know, I see him taking it to a different level. (pre-camp teacher interview, May 2010)

Ms. Tanner saw Jordan as a learner that was a "sponge." He soaked up the information and was able to summarize and apply it in new ways. She believed that he went further in depth with the content and sought to understand it conceptually, or as she described it, "on a different level" (pre-camp teacher interview, May 2010). Ms. Tanner speculated that this aspect of Jordan's identity as a learner of science came from his intrinsic motivation to learn. In the interview, she stated that he was "intrinsically" motivated and then added,

> (•) Um, he's always been a good student, but, I think a lot of his is internal motivation, He'll, he's a kid, ha, I was talking to his mom on the way up here.

> She's like, 'you know, when he was growing up, he'd sit down and read the, encyclopedia.' He would take letter A, just to learn. (pre-camp teacher interview, May 2010)

Ms. Tanner's characterization of Jordan as a learner of science viewed him as a sponge that was intrinsically motivated to learn. He was able to take the information, summarize it, and then apply it in new ways.

The classroom science teacher further described Jordan as a problem-solver and a learner who "thinks outside the box" (pre-camp teacher interview, May 2010). Ms. Tanner responded,

> …he thinks outside the box. Probably more than any student I have. He's always (•) ↑thinking in terms of problem-solving. He's a, he's a good problem-solver. He (•) see-, often sees things from a different perspective, but very, um, (•) involved in the, in the lesson. Listens to everything, takes it all in, participates well. (pre-camp teacher interview, May 2010)

I asked Ms. Tanner if she could provide an example to demonstrate this problem-solving aspect of Jordan's identity as a learner of science. She offered two examples. In the first, she described the recent oil spill and Jordan's ideas as to how to address this ecological crisis. Ms. Tanner described,

> Wel:::l, um, we talked about, just recently, you know, we've been talking about the, oil spill in the gulf. And, he automatically is thinking of ways to solve this problem. He's already designed, I, ac-, actually, on a piece of paper, after we, kinda bantered it back and forth, he, he designed a ship (•) that would be able to, absorb the oil, and actually be able to use it. Rather than, just polluting the water, he's already designed a ship that would be able to suck it out of the water and then actually turn it in to something useful. So, that's

> kinda, he's sees things in a, sometimes, in a different way. Or our ki-, the other kids see it kinda as, 'okay, it's a pollution problem. It's an environmental problem.' But, he goes, kinda that extra step. (pre-camp teacher interview, May 2010).

Jordan also spoke about this example during the pre-camp focus interviewed,

> Um, I think, like, I think when that, when they had the oil spill and we were talking about it in class, I asked a question, like, 'if oil, like floats, why couldn't they just take like a, giant pool skimmer and just run it across the top?' And they were saying like, it's not that easy. So, like Ms. Tanner's like, I said something like, 'Oh, I bet I can, probably build something that would, um, that could fix it,' and she's like, 'if you can build it and you can pay for it, that would be, I would help you out.' So I started just like sketching, on my notes, cause I was going to draw and everything, and it turned out pretty good. And I showed Ms. Tanner and she laughed, and she thought it was pretty cool, and, then I went home and built a little model out of like, legos, cause, that was pretty cool. (pre-camp focus interview, May 2010)

As another example of Jordan's problem-solving skills, Ms. Tanner described,

> And in solving, uh, global warming, you know, we're talking about the ice-bergs melting and the, and the polar bears not being able to swim from iceberg to iceberg and they're drowning. So, he's already designing these, floatable icebergs. Human-made, icebergs, to replace the ones that are, you know, ↑melting. So that the, polar bears can survive.

The descriptions that the classroom science teacher offered helped to exemplify Jordan's identity as a learner of science, particularly with regard to his abilities to problem-solve and think outside of the box. Jordan was a learner of science who was motivated and enthusiastic to learn about science and was ready to apply the information in new ways. He considered the problems of science and constructed solutions to these issues such as oil spills and global climate change.

Jordan indicated that his identity as a learner of science changed in several ways throughout the science camp program. He believed that the focus on affective dimensions at the science camp as well as the chance to work with his friends influenced his enthusiasm for learning science. Jordan's participation in the hands-on, field-based experiences made learning science fun which helped him to remain focused during the learning activities. Jordan explained,

> …the things that I like, it seems like, more, it seems like you hold on to the things you really like and the things you really dislike. And, like, the average stuff, like, it's just kinda like, it's boring. It's just kinda like, you forget it really easily. And if you enjoy something, you're more likely to remember it. And, the more you enjoy it, the, I guess what I'm saying is, if you don't enjoy it, then, you really, you probably know that in the future, you're not going to pursue that career, so you don't really, need to know. (post-camp focus interview, May 2010)

Jordan viewed that if the content was interesting, he would be more focused and learn the science content more readily. He described that the marsh, beach and intertidal field experiences were particularly interesting in this way. Jordan explained these hands-on activities and their influence as he commented during the post-camp interview. When asked what activities influenced his identity as a learner of science, Jordan stated,

> Um, (•) just, I think that that [the marsh trip] was the most hands-on thing cause you had to jump in and I think that when you have something that's

hands-on, somebody's going to remember it (•) more. And, like, even though were no animals really, that we found, um, it was just, like, cool, just being able to jump and down, it was really spongy. (post-camp focus interview, May 2010)

Jordan went on to explain how the intertidal and beach trips also shaped his identity as a learner of science,

> The intertidal. And the, um, going to the Wallops island, was… [they were] the most hands-on. Like the intertidal, you'd get in and you'd collect the organisms. The marsh you were like running through it. Then, um, the, the beach, you got to go and collect the seashells and you got to see the big base with the gatling gun and the rock walls and everything, just pretty cool. (post-camp focus interview, May 2010)

He indicated that these activities were the most hands-on activities during the science camp program which was why he believed these were the most influential on his identity as a learner of science.

Jordan also felt that the opportunity to work with friends helped him to have fun while learning science which kept him more focused on the content. Jordan explained this idea of how working with his friend maintained his focus,

> Well. They let, just like having friends there, I mean focused, it's just like, if you didn't have anybody, in there, if it was you and the teacher, you'd be like so bored to death because if you even turn around and sharpen your pencil without something happening, it would, it would just be so boring. I mean, but when you have like, 20 students and a teacher or two, I mean that's a lot better because you have, your friends are talking amongst yourself, if there's something funny you can laugh. I mean, it just keeps you focused. It's not like,

> ‘oh my gosh, this is so boring and I wish I was out of it.’ (post-camp focus interview, May 2010)

Jordan stated that he was focused because talking with his peers was more interesting and fun than listening to the teacher lecture in the classroom. This aspect of interest and fun made him more engaged in the science content.

Jordan reiterated this notion of fun with his peers in his journal reflections. He wrote,

“If you have a stimulated educational environment with people you enjoy working with, anything should be easy” (Day 1 journal entry, May 2010). On day 2, Jordan wrote,

> Today was awesome! We headed out on the RV Mollusk this morning and caught many unique organisms. There were several types of crabs. However, it was the smallest that packed the biggest punch. This is such a wonderful experiment. I believe this is a great follow-up to our classroom work. Talking with my friends about this trip keeps me focused. They help me understand the meaning of science. (Day 2 journal entry, May 2010)

Jordan described that the activities were hands-on and he was able to talk with his friends which helped with his engagement. The following day he again mentioned the hands-on and friends aspect,

> I had a blast today! I found a sand-dollar. However, first I went to the marsh and got stuck in the mud up to my chest. Talking to my friends I learned so much about the day’s activities. This is so much more hands on than school. (Day 3 journal entry, May 2010)

The journal reflections further illustrated Jordan’s views of how the science camp activities developed his identity as a learner of science. Jordan suggested that the activities were interesting and provided him an opportunity to have fun while learning with his friends. This aspect of the camp, in Jordan's opinion, fostered his enthusiasm toward science learning as it kept him focused and more engaged in the learning activities.

The classroom science teacher noted this increased engagement for Jordan. She noticed that he participated more often and was very interested in being involved in the activities. She responded during the post-camp interview,

> [He participated] probably, maybe, a little more than I expected him to. He was very engaged every question that Margot asked, he was right on it. You know, he sat in the front row whereas Emma sat in the back and I think Jordan was just ready to, you know, jump out there with every little piece of information. Um, which was good. Now in class, he'll volunteer and he'll answer questions but I saw him, probably, more engaged here. (post-camp teacher interview, May 2010)

Ms. Tanner saw that Jordan was more engaged in the activities which she felt was evidenced by his willingness to answer the questions and get involved. She added,

> [Yeah, just that] interest and volunteering and, and quick drawl to be involved in everything. I mean, if somebody was (•) gonna be the one to dig in, in the sand and look for something, it was Jordan. He was down there digging or when they, when he pulled in the net he was the one back there digging through the stuff on the boat, you know, and I didn't see that but that's what they were telling me. He was the first one in, in there. (post-camp teacher interview, May 2010)

Ms. Tanner's comment as well as Jordan's input in the interview indicated that the nature of the science camp activities influenced his identity as a learner of science.

The hands-on aspects and the focus on fun at the camp helped Jordan to feel more engaged in the activities. He was able to work with his friends which he believed kept him interested in the activities.

Another way that I observed Jordan develop during the program was with regard to his efforts to align with the practices of scientists. Wenger (1998) identified one aspect of a identity development as alignment. Wenger defined alignment as coordinating one's energy and activities in order to fit within the culture of a community of practice. Jordan aligned his practices with regard to argumentation and providing evidence to support his assertions. One example of Jordan's alignment with the practices of scientists was during the organism lab. As Jordan and his partner, Steven, read through the descriptions to identify their organism, they cited evidence to support their guesses. In the excerpt, they thought they had identified a particular organism as a comb jelly and they call over Margot to check their guess. When talking with Margot about their organism identification, they cited evidence to support their guesses.

Jordan: Margot, we think we know what this is.

Margot: Okay. Try to think about (why)?

Jordan: Ctenophora. This the only one that's in the phylum.

Damon: Comb jellies.

Margot: What do you guys think it is?

Steven: Okay, we think this is the Leidy's comb jelly.

Margot: Why do you think it's the Leidy's (comb jelly0?

Steven: [Because it says] it's the only one found in the Chesapeake.

Jordan: [It's the only one found=]

Margot: =Okay=

Steven: =and it says its body is an oval somewhat flattened with a combs.

Margot: [Okay.]

Damon: [And also] it says that=

Jordan: =It says something about luminescence, but=

Damon: =it's bioluminescence. ((Margot bends down to examine the comb jelly.))

Jordan: Yeah.

Steven: When you, when its disturbed.

Jordan: Does it need to be like, dark, or something?

Margot: It needs to be dark but, sometimes…you see it.

Steven: OH MY GOSH, it was like, a stripes. Looks like stripes. ((Motions with his pointed finger to demonstrate the striping.))

Jordan: Yeah.

Margot: So, I think you guys are right.

Jordan, Steven & Damon: Yay!

When Jordan and the group members checked their guess with Margot, they cited evidence to explain their assertion that the organism was a Leidy's comb jelly. They believed that the location in the Chesapeake Bay supported their guess and they explained this to Margot. In addition, they used the body shape as further evidence to support that the organism was a Leidy's comb jelly. They asserted that the oval, flattened body shaped supported their guess. This dialogue exemplifies Jordan's development as a learner of science with regard to alignment. Instead of just stating a guess for the organism, he offered evidence such as location and body shape as support. In this way, Jordan was aligning his practice with those of scientists by learning to provide evidence to support an argument.

Another example of alignment also took place during the organism lab. Jordan and his group were working to identify an organism in the phylum Cnidaria. As they worked together, they considered the descriptions in the field guide and accepted or rejected each description based on the evidence they were observing. Each time that they accepted or rejected an aspect of the description, they provided support for their decisions.

Jordan: A coral, I don't think it's a sea anemone so I'm gonna go ahead and go to coral if you guys thinks its=

Damon: =[Why is this a cnidaria?]

Steven: =[It's got the,] it's got the dots that means the corals.

Jordan: Really? Yeah, the (polyps.) That's like=

Steven: =That's gotta be coral.

Jordan: Wait, wait. Look at it really closely. You can see the little things coming out. Is that an anemone?

Steven: No, that's coral.

Jordan: That's anemone.

Steven: [That's not anemone].

Jordan: [okay.] Okay, just wanna make sure. Look at it. It looks really sick.

Steven: Anemones don't live together. ((Steven is referring to colonies. He remembers that anemones are one polyp while corals produces colonies.))

Jordan: Okay. ((laughs))…We're already at the comb jellies again. ((scratches his head.))

Damon: ↑Sea anemones.

Jordan: It must-

Damon: It looks like it's really hairy.

Steven: Alright, wait.

Damon: Stony corals.

Jordan: Op-, -tical

Steven: Octocoral.

Jordan: Okay, so, octocorals. Okay, uh, Dead Man's Finger.

Damon: What?

Jordan: Grows in fleshy to tough lobes and fingers attached to stones, shells, pilings, or suspended from walls and ceiling of quiet, shaded rock pools. Um, No, it doesn't (have) that. ((moves on to the next organism)) Sea whip. New Jersey to the Gulf of Mexico. Lower intertidal to subtidal…stem and branches are slender-

Steven: That's not it. No.

Jordan: K.

Steven: ((reads)) Colony shaped [like a lily pad].

Jordan: [North Carolina to Florida.]

Steven: That's not a lily pad.

Jordan: (Here.)

Steven: Maybe it's in the stony.

Jordan: ((reading)) colonies…Cape Cod to Florida.

Damon: ((points in the book)) It looks more like that than all (the others).

Steven: Wel:::l, no, it looks like this ((points to a drawing in the book.))

Jordan: Right there.

Damon: I know, but more like this than the others.

Jordan: Um…

Steven: [??]

Jordan: ((reading)) Polyps colorless to pinkish. Is that pi-, that looks kinda, maybe, pink?

Steven: Pink?

Jordan: Maybe yellow, like a really, really pale yellow.

Steven: Pink?

Jordan: No. It’s bright cause like (I had paint) that got mixed with yellow. It kinda looks like that.

Steven: What?

Jordan: She does. And I, she told me to trash it.

Steven: It’s not pink, I’m sorry.

Damon: Yeah, that’s not pink.

Jordan: Subtidal. I think maybe it’s this one. Star Coral. ((The boys look up from the book and examine the organism.))

Steven: I don’t-

Damon: Yeah.

Steven: I really don’t know [what this is.]

Jordan: [Yeah.] ((reading)) United by a thin crust or sometimes forming low, branching groups. Yeah, that kinda looks like it’s branching.

Steven: Yeah. ((Says tentatively.))

Jordan: Let’s ask her.

Steven: Wait, it is kinda low branching.

Jordan: It looks like, that, I mean that thing looks like a branch.

((Margot comes over to the group to verify their guess as to the ID of their organism.))

Jordan: Alright, we think that this ((points to the organism in the bowl)) is a ↑star coral.

Margot: Why?

Jordan: Because, it say, it’s like, it’s low and stump like. ((Points to the organism to show this feature to Margot.))

Steven: And it, and it’s coral thingies are really close together.

Jordan: Yeah, it’s united by a crust and it like branches out and it’s like= (Jordan uses his hand to demonstrate branching out)

Margot: =does it go with these pictures?

Damon: And it says subtidal [to shallow depths]

Jordan: [and it looks] similar to like, that.

Margot: Okay. You're right, it's a star coral.

In this episode, the learners progressed through the field guide and accepted or rejected certain descriptions and organisms. As they considered each option, they provided evidence to guide their decision making. For example, Steven asserted that the organism was not an anemone based on the following evidence: the organism had bumps like a coral and anemones do not form colonies. Later in the dialogue, Jordan rejected another organism based on the color. He believed it was not a particular coral and he offered the different coloration as evidence for this decision. When Margot comes over to check their guess, Jordan offered support for his group's guess. As evidence, he suggested that their organism was branching, low and stump like which matched a particular description. In this way, Jordan and his peers used language to align their practices with those of scientists. Jordan learned to offer evidence to support his assertions and in this way, his identity as a learner of science developed.

Similar to the other case participants, I observed Jordan engage in the use of everyday language to make sense of the science content. A particular example of this occurred during the micro-organism lab when Jordan and his partner, Steven, observed plankton. In the dialogue that follows, Jordan and Steven used everyday language to describe the features of the plankton that they observed.

Jordan: ((Jordan and Steven are viewing the sample under the microscope.)) I can't find it. Eww. (That one looks like a baby back caterpillar.)

Steven: BABY CATERPILLAR. ((sings))

Jordan: He was like yellow (we're like in the same place) but not really. We're like moved, it or, to the edge.

Steven: (Eww.) It looks like a giant caterpillar. I'm not sure. This little thing near the air bubble kinda looks like ((lice)).

Jordan: That one looks like it's gold.

Steven: Eww.

Jordan: We have one that's like the size of a (caterpillar).

?: Size of like, this.

Jordan: Yeah. It was huge. (It's still showing). Make sure it's clean. It's like a whole-, look at it. ((Uses his shirt to clean off the lens and then looks in the viewfinder again to observe their sample.)) There's two. Look, look, look. I see something. On the top.
((Steven excitedly jumps up and quickly looks in the viewfinder.))

Steven: HOLY CRAP. What's it doing?

Jordan: …It's eating so-, some little baby. ((yells out)) It's stuck on something. It's up at the top. Dude, there's like all these little ones coming out over the big ones….((laughing)). Hey, there's one in theirs, Steven, there's one in theirs that keeps doing this ((uses his pen and makes a circular motion to demonstrate how the plankton in the other group's slide is moving.)) It keeps doing that. ((Jordan addresses another group)). Their plankton keep going like this ((uses his pen again to create a circular motion. He also creates a zooming noise to further highlight how the plankton is moving.))

In this excerpt, Jordan and Steven used everyday language to describe the features of the plankton. Although at this point they lacked the technical terminology for describing the plankton species, they were able to engage in a conversation about the characteristics of the plankton that they were observing. They used non-scientific phrases and terms such as "it looks like a caterpillar" and "lice" as well as hand gestures and zooming noises to describe the features of the plankton that they were observing. The opportunity to engage in everyday language during conversations may have positively influenced Jordan's identity as a learner of science. Jordan explained during the post-camp interview, "I think that it's (•) cool like if you go out (•) and you can just like tell people what you know about it. And sometimes, people don't know about it, so it's cool to tell them" (post-camp focus interview, May 2010). By using everyday language, Jordan was able to engage in a conversation and describe the plankton. This connected with his interview statement in which he thought it was "cool" to "tell people what you know." Being able to engage in the conversation using language that was familiar to describe the plankton may have further developed Jordan's identity as a learner of science.

Jordan's identity as a learner of science also appeared to be positively influenced by the science camp with regard to his confidence. There were slight changes in how he viewed his abilities as a learner of science. Jordan's classroom science teacher pointed out the changes that she noticed, "I, I think he's gained confidence. You know, I think he's always been confident but I think this was kind of a (•) boost for his, his depth of confidence" (post-camp teacher interview, May 2010). She indicated that as a result of the science camp he might make the following comment about learning science, "This is something I can do and this is how easy it is" (post-camp teacher interview, May 2010). When I asked her to explain her thinking about his confidence, she added,

> I, I think it's probably a little stronger. Deeper. You know, I think before it was a surface confidence but maybe a little deeper now… just that depth of confidence um, (•) I think when he sees things now he will be able to kinda, more than just a book knowledge, I think he's gonna have true knowledge of how things work… But…I just think the intensity of this program probably (•) Damon him out a little bit more. (post-camp teacher interview, May 2010)

She felt that the science camp program "Drew him out a little bit more" and further deepened his level of confidence. This was evidenced in his assertiveness and willingness to take leadership roles.

I observed this assertiveness and leadership that the classroom science teacher spoke to. Initially, he stood back and let others lead the science activities at the start of the program. As his confidence developed, I observed him take leadership in helping to direct the learning tasks. This was particularly notable during the intertidal field experience. Jordan led the activities during this field experience by helping to divide the tasks and organize the group.

Jordan: Okay, there's like a whole bunch of shells, just leave em' in there.

Jack: I WANNA SHOVEL.

Jordan: Here, I just [??]

Tyler: ↑Oh my gosh, the little (crab)?

Sheila: AWW.

Tyler: (He's so cute.)

Jack: That one's movin', that one's movin'.

Sheila: [??]

Jordan: Alright, ready?

Tyler: Don't hurt him.

Jack: NO, HOLD ON.

Jordan: Guys, you gotta get ready. Guys. ((Jordan adds a scoop of mud to the sieve box).)

Jack: [??]

Tyler: They're probably [all still alive.]

Jordan: [Guys, stand back]. Wanna [??]. Do it Jack.

Tyler: (What did you hit)?

Jack: I don't know what it was. It's moving.

Jordan: Why, why don't we shift, like=

?: =There's a dead crab.

Jack: Alright.

Jordan led this sieving activity during the intertidal field experience. He directed his group members to leave the shells and to get ready for sifting the shovel of mud. He assigned tasks, telling Jack to use the shovel for collecting mud to sieve. Jordan offered a suggestion to move to a new location for digging and the group shifted as requested. In this episode, Jordan demonstrated that he was assertive as he offered suggestions and assigned tasks during the sieve box activity on the intertidal field trip. This assertiveness and leadership prompted the classroom science teacher to consider that Jordan's identity as a learner of science developed in terms of his confidence.

A final way that Jordan's identity as a learner of science was positively developed by the science camp program was with respect to his idea of how others viewed him. For Jordan, their seemed to be a tension between his membership in the community of science learners as well as his role as an adolescent. Jordan believed that the science camp program helped others to see that he was not just a "geek" or "book learner" but also a hands-on person that was not afraid to participate actively in the learning. Jordan explained before the science camp,

> I think I'm really good, in science, um, and like my teachers. I think that, I'm kinda like that, the one, that one nerd in the corner (laughs). Um, and I, I don't think my teachers think of me that way, but, I think, like, some people, [??], and it's just like a joke. (pre-camp focus interview, May 2010).

He echoed this idea in his journal reflection where he wrote, "I've always loved science! Ever since I grew a lima bean plant I have been an avid science geek" (Day 1 journal entry, May 2010). Although he took pride in this characterization, Jordan believed it lead others to see him as a book learner and afraid to engage in hands-on activities. Jordan felt that the opportunity to engage in the hands-on science activity guided others in seeing him in a new way. In the post-camp interview he described,

> I think that now, after everybody's seen me getting in there, that they don't, they think about me, I'm more of a hands-on, that I can do it. Which I've always been able to do stuff, I just haven't had the opportunity…. I think everybody's like, thinks of me, well not everybody, but, I think people think of me like I'm afraid to do stuff. (post-camp focus interview, May 2010)

By engaging and participating in the hands-on activities as the science camp, Jordan assumed that others would see him in a different way. In this new view, others would see him as someone that was not just a book learner, but as a learner who participated in hands-on activities. He attributed this change to the opportunity to engage in hands-on science learning activities at the science camp. He suggested that he had fewer opportunities for hands-on learning in the science classroom. Jordan's shifting perception of how others viewed him demonstrated an additional area of his identity as a learner of science who was influenced during the informal science education camp.

One aspect of Jordan's identity as a learner that was maintained throughout the science camp was his interest in pursuing a science career. During the pre-camp focus interview, Jordan expressed an interest in pursuing a science career in alternative energy. He stated his specific career interest in alternative energy,

> Um, and alternate energy. Yeah, just like, being able to, take from oil and gas and natural gas and just change it and make it like wind power and hydroelectric. And, just change it, in to like a totally clean energy source, like, it just naturally occurs. I think that'd be pretty cool. (pre-camp focus interview, May 2010).

This interest in a science career was sustained throughout the science camp. After the science camp, Jordan indicated that he still planned to pursue a career as an environmental engineer and hoped to explore alternative energy.

Summary. The science camp program supported aspects of Jordan's identity as a learner of science. He began the program with an interest in science and had confidence in his abilities as a learner of science. Jordan suggested that the opportunity to engage in hands-on activities with his peers helped to shape his enthusiasm to learn science as well as helped others to view him as more than just a "geek" or book learner. Ms. Tanner, his classroom science teacher, believed there were notable changes to Jordan's confidence. As evidence, she suggested that he was more assertive and took leadership roles during the science learning activities. Finally, Jordan maintained his interest in pursuing a science career in environmental engineering throughout the science camp program.

Celeste: "I could see myself as a scientist"

The case of Celeste contrasted with the other case participants. Although some aspects of Celeste's identity as a learner of science were reinforced, there were other qualities that were not positively developed as a result of the informal science education camp. Celeste was an African-American female that attended the science camp program as a 7^{th} grade student from Thomas Jefferson Middle school. Unlike Emma and Jordan, Celeste was not a student in Ms. Tanner's pre-AP life science course. Instead, she attended the program as a student from Ms. Henry's "normal," life science course (pre-camp teacher interview, May 2010). The classroom science teachers described that there were extra spaces available on the field trip and several students that were not in the pre-AP course were selected to fill those spaces. Celeste was one of the students selected for these available spaces. She was the only African-

American student attending the MSC field trip from the Thomas Jefferson school group. She was outspoken during the interviews and expressed a strong interest in science, particularly with regard to learning about animals.

Celeste began the science camp program as a learner of science who expressed an interest in learning about science. She was particularly focused on learning about animals which fostered her interest in learning science. I asked her why she was interested in science during the pre-camp interview to which she responded,

> Um, in elementary school, kinda of like engaged me to keep on going with science because, I've just started, we started learning about a few animals, but then, in 6th grade, we got to learn a little bit about animals, but not much, cause it's, and then this year, we're, since we're in life science, we get to learn more about animals. That's my favorite part about science, cause the animals and their environment and habitat…now that I'm in life science, I learn about different animals, different types, different unique things and characteristics about them. (pre-camp focus interview, May 2010)

Later in the interview, she added, "Also you get to learn the unique things about different animals and like, their shelters and where they live and what they eat and their habitat and different things like that" (pre-camp focus interview, May 2010). Celeste's engagement in science stemmed from her love of animals and her interest in learning more about them. She was eager for the MSC science camp program and hoped to learn more about animals during the trip. When asked what she hoped to learn at the science camp, she answered, "I'm hoping to learn about different animals and their population and species. Um, because I like to learn about different animals and their names, I've never like, heard or saw before" (pre-camp focus interview, May 2010).

I noticed that much of Celeste's identity as a learner of science was situated in this aspect of learning about animals. During the pre-camp interview, many of her responses to the questions I asked were framed within her interest in animals. For instance, Celeste's view of science was defined in terms of animals. In response to the interview question, "what is science," Celeste explained, "Like studying different environments and studying living things and different things in, in the world…Um, because you're learning about different, ob-, objects or different things in the world that, that's different from everything else, different from other subjects" (pre-camp focus interview, May 2010). Her view of the importance of science included animals in her explanation,

> Because (•) you use science in your everyday life and if there wasn't science, you wouldn't know about all these different species and what these different populations are and like, ∨different things….Also it helps in knowledge of animals and different things like that. So, you know, you want feed it the wrong thing if you ever have any kind of pet or anything. (pre-camp focus interview, May 2010)

For Celeste, the topic of animals was one that she enjoyed and that helped to spark her interest in science. Her view of science incorporated this interest. Notably, she viewed science in terms of animals. She defined science and saw the need and use of science in everyday life through the lens of animals. At the camp, she hoped to acquire more knowledge related to animals.

Celeste's interest in learning more about animals motivated her attendance on the trip. Her classroom science teacher explained that she has had some difficulties in her home life. Celeste was being raised by her grandmother who did not necessarily have the money to fund her field trip to the science camp program. However, Ms.

Henry, her classroom science teacher, suggested that Celeste was very excited and motivated to attend the science camp which prompted her to participate in many fundraising activities to raise money for her field trip. Both of the classroom science teachers on the field trip explained during the pre-camp interview (May 2010),

> Ms. Henry: She's been very, very excited about, like SO excited about this trip. Getting, being able to come out, because I don't feel like she has a lot of opportunities. Um, in her family life, she's just been ecstatic about this whole, trip thing.
>
> Ms. Tanner: She, one-, I mean, we did a little fundraiser. Some of the kids participated, not all of them did, but some of them didn't even need the money to do it, but, um, she sold more than like half the other kids combined.
>
> Ms. Henry: Yeah.
> Ms. Tanner: I mean, she=
>
> Ms. Henry: =She does=
>
> Ms. Tanner: =She really got out to make the money to get to come.
>
> Ms. Henry: [Umm-hmm]
>
> Ms. Tanner: [So, I don't, to me] that was, you know, a sign that she was motivated to want to be here.

Celeste was very motivated by her love of animals to learn more about science. This motivation, according to Ms. Tanner and Ms. Henry, was evidenced by her drive to attend the field trip program. Although she was not a student in the pre-AP life science course, her interest and motivation in science prompted Ms. Tanner and Ms. Henry to select her for the trip. Celeste was motivated to raise funds in order to attend the trip.

I wanted to learn more about Celeste's confidence in her abilities as a learner of science. Before the science camp, Celeste described that she was good at science but her answers seemed to be viewed from the perspective of school science. Further, there were notable areas where her confidence could be improved from a program such as the MSC science camp. Celeste reflected in her pre-camp journal entry,

> I see myself as a great learner. What I do is take notes and ask important questions. My teacher sees me as a great learner of science. Yes, but sometimes it can be my weakness. Like, for example when we talked about something other than animals I sorta lose my interest. I do learn science easily it's like it comes right to me. I have always made A's. I am very confident because it's my favorite subject and I love and enjoy learning science. (Day 1 journal entry, May 2010)

The journal entry illustrated that Celeste saw herself as confident and a great learner of science but she believed there were areas of weakness, specifically during times when she learned science topics other than animals.

In the interview, Celeste also spoke to her abilities as a learner of science. Celeste described,

> Um, I think my, my teacher thinks of me as a pretty good worker in science, because, she, uh, of course I wouldn't have got chosen for this because, I think, cause I take notes all the time, I like, I like science, and I've always gotten pretty good grades in it. My parents know that I like science, so they kind of encourage me, you know, when there's an animal or something they, you know, we, we go to like, a lot of zoos, and I get to learn different species (over that). (pre-camp focus interview, May 2010)

Celeste's response during the interview demonstrated that she had some confidence in science, which she felt was evidenced by being selected for the trip. It is important to note that she believed her teachers saw her as a "good worker in science." Celeste seemed to hold a view that working hard may translate to abilities as a learner of science. Also notable was her explanation of her abilities within the figured world of school science. She saw herself as good in science because she took notes and achieved good grades. Later in the interview, she expanded on her view of herself as a learner of science,

> I kinda like, like, I know it sounds boring, but I like to listen to the teacher's lecture cause you can take notes and stuff. Then you can go back over them and you can learn about. And also, I like doing hands-on, like, different experiments cause you get to learn different things and things like that with experiments. (pre-camp focus interview, May 2010)

For Celeste, she enjoyed learning through the Ms. Henry's lectures because she was able to record notes and review them to learn information. Celeste's identity as a learner of science was viewed through the lens of school science. In this figured world of science, achieving good grades, working hard, and studying your notes from a lecture were attributed to success in science. Celeste's confidence in science stemmed from her ability to participate successfully in these aspects of school science.

Ms. Henry expanded on Celeste's confidence as a learner of science. When I asked Ms. Henry during the pre-camp interview about Celeste's confidence, she stated,

> She participates, often, she's always one of the first ones to raise her hand and, question after question after question, I have to tell her, sometimes, to either, you know, let the other students, um, a chance to participate. So, she's very active in the class… She's always the first to volunteer to do, um, any-, anything, she'll tell, she has no problem telling the students what they need to do, so, kind of, she's very active in the class…Um, she just (•) volunteers, just, I mean, pretty much volunteers, just (•), she wants to be involved in whatever is going on in the classroom… She, um…she wants to learn (•) and that's obvious. She, she does ask questions, um, (•) but she'll also questions about

> (•) things I know she already knows. But, she won't (•), she-, it's just like she's not confident in what (•) she (•) she doesn't want to get something wrong. Like, for opening activities, we have a question right when you come in, and it'll be a question right out of our notes, so it, but everyday she comes up and asks me, 'is this what you want?' Um, and everyday it, it's exactly what I want, but she just wants to make sure that she's not going to get it wrong. So, she's always, generally she's always right, but, she just wants to make sure she's right. (pre-camp teacher interview, May 2010)

Ms. Henry's view of Celeste's confidence as a learner of science highlighted that Celeste was interested in science and participated often in the science classroom. However, Celeste at times lacked confidence and would ask Ms. Henry questions to which she may have already had an answer to ensure that she was correct. Later in the interview, Ms. Henry continued,

> She's very interested in it [science] and she, again, she asks questions about it. Um, (•) but then, she's very cautious, when she does answer tests, she's the same way. She'll ask me questions about (•) test questions. She'll explain it to me, but she just wants to make sure she's reading it right [??]…she'll still vol-, but in class, she'll still volunteer to tell ans-, give answers or whatever without asking. But, if it something that's right or wrong on paper, she always, always asks…it would just be verbally, yes, on paper, I think she's confident but she just wants to make sure that, she just needs that extra encouragement that she is doing, what she needs to be doing. (pre-camp teacher interview, May 2010)

This characterization of Celeste suggested that she had confidence when participating in the class conversation and answering verbal questions. In writing, on the other hand, Ms. Henry believed Celeste lacked some confidence. When there was greater accountability (on paper for tests and other graded material), Celeste asked questions and needed encouragement.

Although Celeste and Ms. Tanner expressed in the pre-camp interviews that Celeste participated often in school science, I observed a conflicting view of her during the science camp activities. At times, she was eager to participate in the activities while at other times, she was quiet, stood back and disengaged from the activities. For example, on the research cruise, she was eager to be involved in the data collection activities and was particularly excited during the otter trawl when the group collected a number of organisms (research cruise field notes, May 2010). During the intertidal field experience, she excitedly skipped through the water and was eager to collect shovels of mud for the sieve box (intertidal field experience, May 2010). On the other hand, there were times when Celeste did not participate with her peers and even disengaged from the science learning activities. One instance was during the dunes field experience on Wallops Island. The group had an opportunity to collect shells and organisms that had washed ashore on the beach. While collecting organisms, Celeste left her group and did not engage in the conversations they were having (Wallops island field notes, May 2010). Celeste also worked alone during much of the organism lab. The participants were instructed by Margot to work in groups to complete the identification tasks. Celeste chose instead to work alone. When she did work with a group, she did not participate often. I observed her walking around the classroom and drawing pictures on the front board (organism lab field notes, May 2010). The discrepancy between her professed interest and love of organism and her disengagement at times suggested that for Celeste, the science camp program may not have been as influential as it was for the other case participants.

Celeste's hesitation and disengagement in the learning conversations appeared to result in less substantial changes to her identity as a learner of science.

Another discrepancy I noticed in Celeste's comments and then actions during the science camp was with regard to animals. Celeste talked extensively about her love of animals in the pre-camp interview. She was interested in science and much of her view of science focused on animals. However, at the science camp program, I noticed that she was scared of animals. As an example, on the intertidal field trip a group member noticed a crab. Celeste jumped away and commented that she was afraid of it (intertidal field notes, May 2010). On the dunes field trip, I showed Celeste the skeleton of a horseshoe crab and in response, she jumped back, her eyes got big and she yelled, "it's alive" and threw the shell (Wallops island field notes, May 2010). On this trip, she also found the exoskeleton molt of a lady crab. She motioned to pick it up, hesitated, and then commented, "I don't want to touch it" (Wallops island field notes, May 2010). This discrepancy between her professed love of animals and her unwillingness and fear of the animals provided insight into Celeste's identity as a learner of science. I speculate that in school science, Celeste was eager to learn about animals. However, the opportunity to interact with animals in the real-world was a new experience for Celeste, one in which she was still adjusting. Celeste's identity as a learner of science was one in which she was eager to learn information about animals, but was still hesitant to engage and interact with organisms. This aspect of Celeste's identity did not appear to notably change as a result of the science camp program.

Both of the classroom science teachers also noted her change in participation at the science camp program. During the post-camp interview (May 2010), they explained that Celeste was quieter and less participatory on the field trip than they usually observed in the classroom. They commented,

> Ms. Tanner: I'll answer that. Missy. Um, in, in the classes I was with her in, she (•) didn't vocalize (•) and actually participate a lot orally, um, when questions were asked, she didn't volunteer a whole lot, um, I think if a question was presented directly to her she probably would have, but as far as the group (•) dynamics, I, I don't remember her ever raising her hand or (•) um, volunteering a whole lot of information.
>
> Kelly: Um, and, is that, I assume that's different based on what you mentioned in the pre-[camp]. Can you talk a little bit about that?
>
> Ms. Henry: Yes. In the classroom…In the classroom, she (•) always, I don't know if it's cause she has her notes prior, but she's always (•) hand up all the time, otherwise, I mean, I have to tell her to put her hand down so other people can get (•) um, a chance to (•) answer.
>
> Kelly: So can either of you speculate about why you think she might have been more quiet in this setting?
>
> Ms. Henry: She may have, Kristen, she may have been a little bit out of, out of her element, just in terms of, she's never done (•) from what I've gathered, this is the first time she's ever done anything=
>
> Kelly: =This type of opportunity=
>
> Ms. Henry: =yeah. This type of activity. Um, and she may have just been taking it all in. Um, you know, just kind of absorbing what she could.

Both teachers noted an observable shift in Celeste's participation during the science learning activities. They speculated that she may have participated less often because she didn't have her notes to look back at or perhaps because she has not had opportunities to learn outside of the classroom in a novel setting such as the camp.

Another explanation Ms. Tanner and Ms. Henry suggested was that Celeste now saw that science could be learned hands-on which resulted in her lack of participation during the verbal lectures and educator question-answer activities. Ms. Tanner reflected on Celeste's participation during the interview, "I saw her probably doing more of the hands-on, um, enjoying that more than the actual, verbal discussion" (post-camp teacher interview, May 2010). Ms. Henry added, "I don't know if, again, if it's more of, she's excited to be active in doing something. Um, you know, that could very well be it" (post-camp teacher interview, May 2010). This explanation may also reflect the different figured worlds of science learning that Celeste now had an opportunity to experience. In the norms of the figured world of school science, Celeste saw that the lecture and teacher-question, student-answer method of participation was favored which was reflected in her increased verbal participation in the classroom. On the other hand, in the figured world of informal science education, the norms of this culture favored experiential-based and hands-on science learning. As a result, Celeste may have come to see herself as successful in this world through other modes of participation.

Although in some ways Celeste's identity as a learner of science was not as positively influenced as the other case participants' identities, there were areas of her identity as a learner of science who appeared to develop. Specifically, Celeste viewed that the opportunity to engage in conversations with her friends and learn hands-on helped with her interest and engagement in science. Celeste, in the post-camp interview, mentioned how talking with her friends and working in groups influenced her interest in science. She explained,

> I think, yeah, it's really fun working with groups cause if you make a mistake, some people learn from your mistake. But, sometimes it's good to work alone cause when things, some things you can do by yourself. But also it's really fun working in groups too. (post-camp focus interview, May 2010)

By working in groups with her friends, Celeste felt more comfortable because if a mistake was made, other members of the group could learn from that mistake. Additionally, Celeste developed with regard to affective dimensions of her identity as a learner of science. Celeste indicated that working in groups at the science camp was fun.

Similar to Jordan's comments, Celeste explained that working in groups with her friends kept her focused. The group talk also helped to expand content knowledge as each group member brought different information to the conversation. Celeste stated during the post-camp interview,

> Well, um, well, I think it's kinda like a lot better. They help you in science if they're into the same topic you're in. And, me and my friend, um, we're both into that same topic and the same kind of thing...And so, it helps us, it helps me learn more cause she's in to the same thing and she won't lose her focus enough so I won't lose mine…Yeah, like if we, if we have different information, if she didn't know anything about it and what-, if she, whatever information she had to share, well if we both, pu-, put it together and it all just makes like, you know, put more together. (post-camp focus interview, May 2010)

Celeste believed that the group conversation influenced her identity as a learner of science in the following ways: group members learned from one another's mistakes, group members kept Celeste focused, the group conversations were fun, and the conversations helped contribute to her science content knowledge as each member brought information to the activity.

The experiential learning and hands-on activities of the camp further influenced affective dimensions of Celeste's identity as a science learner in terms of interest, enthusiasm and motivation. Celeste indicated that field experiences helped her to observe authentic science in the real-world context. In the post-camp interview, she explained, "Like after you learn about something, if you go and, if you go and see it, you can observe it better cause you know what you're talking about with it" (post-camp focus interview, May 2010). She expressed that the field experiences were fun and helped her to practice authentic science,

> Well, it kinda changed cause at first, you know, I was really into animals and everything but once I saw wetlands, how fun it was, even though it was kind of a little icky, but it got, it got really fun after we got in there, it, it was a lot of fun and I enjoyed it…Yeah, well, you know, it, the icky part was, it wasn't that fun, but, after I got in there, you know, it, it's kinda fun being in the environment of different animals…Because the mud was hands-on and you got to actually really experience and feel what a, what marshes are and so it just, learning and talking about it. I got to actually feel and see what the, to see how squishy and stuff that it was. (post-camp focus interview, May 2010)

In her journal reflections, Celeste expanded on the field experiences. She wrote, "I got to physically experience different organisms. Yes I am different because in class you learn but here you actually experience organisms and there environment. I made me feel more confident about science" (Day 2 journal entry, May 2010). Celeste believed that she was able to physically experience the organisms which helped her to feel confident about science. The following day, she wrote in her journal, "It was a good influence cause I could see myself as a scientist. I got to do the actual thing. A lot more confidence in the science field" (Day 3 journal entry, May 2010). For Celeste, the opportunity to engage in authentic science activities in the real-world of science helped her to see herself as a scientist. She stated that she "got to do the actual thing," indicating that the authentic experiences at the science camp helped her to try on the true identity of a scientist.

Another way in which Celeste's identity was shaped by the informal science education camp was with regard to her views of science. At the beginning of the camp, Celeste's views of science focused on animals and she was unable to articulate her views of other topics. The camp helped Celeste expand her view of science to other areas and topics. For instance, Celeste learned about topics of science related to environment which she incorporated into her view of science. During the post-camp focus interview, she described the importance of science in everyday life,

> Well, today how I used, um, science was I got to learn how some people how they destroy wetlands when they build like the McDonald's store, how he moved the wet-, moved the bushes. How he moved 'em and then he got the drive thru in there and it ruined the wetland. (post-camp focus interview, May 2010)

Prior to the camp, Celeste talked in terms of animals and believed science was important in everyday life to learn about animals and their care. However, in the post-camp interview, she has expanded her view of science to also included environmental topics.

I speculated that this change was a result of the MSC educator's discussions of the environment and human impacts on the environment. Celeste explained this during the interview. When asked "do you need science," she responded,

> Yes, because there's a whole lot of other things that you do like when you step out [in the environment], you, you can learn more about different things, how people ruin it and things like that. And you can try to help it. (post-camp focus interview, May 2010)

Celeste learned new aspects of science through her conversations with the MSC educators. She learned more about the environment and the specific human impacts on the ecosystems studied at the science camp.

This new interest in the environment for Celeste reinforced and expanded her thoughts of pursuing a career in science. After the camp, Celeste expressed that she maintained her interest in potentially pursuing a career with animals but was now considering an environmental career as well. When asked to discuss her career ideas, Celeste explained,

> I kind of think, um, it has changed. Cause, well I see myself working with animals but also, I kinda like, want to be that kind of person who helps try to, save the wetlands, and the people who ruin em. (post-camp focus interview, May 2010)

She continued,

> It, it changed for me because, I, I after I got thinking about it, after we just kept thinking about it, I just got so into the like, I could, we could help save the marshes and different wetlands that people are starting to ruin. (post-camp focus interview, May 2010)

When further prompted to explain how the science camp influenced this change, Celeste explained,

> Well, when we did, when went in the marsh, when we did the intertidal, it was just so pr-, it was just so a-, awesome for that, the beach was so pretty and if you think about it, if you save all these wetlands it could just be, be just as pretty. (post-camp focus interview, May 2010)

For Celeste, the opportunity to experience and appreciate the aesthetics of the environment prompted her to shift her career ideas and express an interest in pursuing an environmental science career.

When asked if she was still interested in a career with animals she mentioned that she was interested in helping save the wetlands and marshes and the animals that were in it. A new career that she was considering was cleaning up animals after oil spills. She commented, “Yeah, like cleaning up, like, kinda like cleaning up the animals from all the oil spills and different, and different things like that” (post-camp focus interview, May 2010). This was a career that Celeste believed would connect her love of animals with her new interest in the environment.

Celeste’s experiences at the science camp and her conversations with the MSC educator influenced her identity as a learner of science in terms of her pursuit of a science career. Initially, she was considering a career with animals. Throughout the science camp, she was able to experience the environment and appreciate it for its beauty. Further, the MSC educators discussed human impacts on the environment and described specific examples of the ways in which the local marshes and wetlands had been impacted by development. These aspects of the camp prompted Celeste to expand her ideas related to a science career. Instead of just considering a career with animals, she was now also considering a career related to the environment or possibly a career that incorporated both areas of science.

The classroom science teachers suggested one final area in which Celeste developed as a result of the science camp program. They indicated that Celeste developed socially and learned to interact more comfortably with her peers during the other, non-science activities at the camp. When asked if there was anything they wanted to add about Celeste, Ms. Tanner and Ms. Henry commented, Ms. Henry: I think, I think this experience, I think this experience has made her more confident in, maybe, um,…in terms of socially being around groups of people. Um, and I think this will, this will definitely come back in to the classroom. I feel like this has been definitely beneficial for her and I think, through this experience it may bring out more of her, more, um, of her in the classroom.

Kelly: Can you elaborate more? You said you think it will translate to the classroom, can you talk more about how you think that's going to happen?

Ms. Henry: I think maybe just from what I've seen her, cause she has been talking to people that she mentioned one of the students that she hadn't talked to since 5th grade. Um, and she's been, you know, interacting with them and I'm hoping that instead of just interacting with her group, she has a few people that she'll um, talk to in class and maybe (•) um, instead of just commenting, maybe bouncing off ideas in class or brainstorming in class, a partnering, when we do group work, maybe more, you know…more than what she had been doing.

Ms. Tanner: Just the, the social part, I mean, I see her, she came out of her shell cause when I first met her a few days ago she was just quiet and you know, just didn't seem, now SHE just, is personable, um, you know, and I think that's gonna translate when we go back to school that, just the confidence, that, you know, 'this is something I got to do.' And, I hope she'll see that education is going to take her, hopefully out of her home situation. Not knowing exactly what that is, but knowing it's not the best. That maybe, ((clears her throat)) excuse me, this will give her the confidence that (•) you know, 'if I continue to work hard, then I'll get these opportunities again.'

Ms. Henry: When I first, when she first got on the bus, she was sitting by herself cause she didn't talk to anybody the WHOLE way down. And then=

Ms. Tanner: =Now we can't shut her up (laughs)=

Ms. Henry: =yeah ((laughs.)) I was worried about her. And then, you know, I was trying to talk to her because I was behind her and then now she's just 'dah-, dah-, dah-' ((indicating that CC is chatty.))

Ms. Henry: I think she will be more confident in terms of she's talked to me, she's mentioned to me the things that she hasn't had an opportunity to do and I feel like she=

Kelly: =such as=

Ms. Henry: =Just um, she talked about never having, you know, flown in a plane before. She had never gone to the beach before…Uh, but, you know, she hasn't had a lot of opportunities to do things, so…Um, more, definitely what I would, what I've seen is more talkative, um, maybe outside of, the actual, class. (post-camp teacher interview, May 2010)

Ms. Tanner and Ms. Henry explained that Celeste appeared to develop socially and learned to interact with her peers. They noted that the opportunity to attend the trip and have the experience may have helped Celeste to open up. On the trip, she interacted with the other participants on a personal level more often than she did in the classroom. Ms. Henry hoped that this would influence her participation in the classroom and she would learn to brainstorm and collaborate with her peers back at school. Their comments helped to illustrate another aspect of Celeste's identity as a learner of science who might have an influence back in the classroom.

Summary. The case of Celeste provided a contrast to the experiences of the other case participants. In some ways, Celeste's identity as a learner of science developed, particularly with respect to affective dimensions of her identity as well as her views of science and her pursuit of a career in science. Celeste described that her interest, motivation and enthusiasm for science learning were developed through the opportunity to engage in conversations with her peers. These aspects were further influenced by the experience-based, hands-on activities of the science camp. She was able to engage in authentic science activities and try on the identity of a scientist. However, there were ways in which Celeste's identity was not as positively influenced by the camp. I observed many times when she did not participate in the conversation and even was disengaged in the activities. I watched her leave her group and stand back from the activities. This was further noted by her classroom science teachers who noted that she was less participatory during the science learning activities at the camp as compared with her participation in the classroom. Celeste's experiences as a learner in the science camp setting were unique compared to the other case participants. Celeste was the only case participant that I noticed disengaged from the science camp activities. She was the only case where her identity development did not appear to be as notably influenced in a positive way by the science camp experience.

Summary of Case Narratives

Each of the narratives for the case participants provides insights into the ways that particpants' identities as learners of science were influenced by the MSC science camp program. Table 6 summarizes the key insights from each case participants' experiences at the camp.

Table 6

Key insights from case narratives.

Case Participant	Initial Aspects of an Identity as a Learner of Science	Key Insights	Areas of Identity Development as a Learner of Science
Brynn	-Expressed an interest in science, particularly in Earth science and marine biology -Tentative and hesitant about learning science -Questioned her abilities as a learner of science -Perceived that others may not see her as a learner of science -Was considering teaching as a future career	-Brynn was able to use everyday language and familiar activity structures to make sense of science content which helped her to engage in conversations and see herself as a learner of science. -Brynn used language to position herself as the type of person that enjoyed learning about and interacting with organisms. -Brynn indicated that the conversations helped her to learn more about her peers and to feel comfortable learning science and asking questions. -Brynn viewed the science activities of	-Developed greater confidence in her abilities as a learner of science -Extended her interest in science learning -Considering a science career

		the science camp as fun which influenced her interest and motivation in science learning.	
Hannah	-Beginning to enjoy science this year, especially Earth science -Lacked confidence in her abilities as a learner of science -Considered pursuing a science career in marine biology or forensics	-Hannah believed that she was more free, less confined, and more comfortable in the science camp setting. -Hannah was able to participate in equitable conversations with her teacher. -Hannah suggested that the conversations with her peers influenced her willingness to take risks. -Hannah believed that the hands-on and field-based activities as well as the opportunities to converse with friends influenced her interest in science. She viewed that the science activities at the camp were fun.	-Developed greater confidence in her abilities as a learner of science -Participated more in social interactions -Came to see that learning science could be fun -Growth in her view of science -Maintained an interest in pursuing a career in science
Dale	-Interested in most areas of science -Confidence in his abilities as a learner of science -Highly motivated to learn science -Intended to pursue a career in health science	-The opportunity to work in peer groups helped Dale to see others as capable in science. He learned collaboration skills and began to share the learning tasks with his peers. -The lack of grading pressure and competition in the science camp setting helped Dale to feel	-Maintained confidence -Developed collaboration skills during group work -Became interested in new areas of science such as marine science -Maintained an interest in pursuing a career in health science

		more relaxed. As a result, he was able to show more of his personality and learn more about his peers. -The marine science activities of the program helped Dale to develop an interest in marine science topics. -The authentic science activities influenced Dale's level of comfort as he did not have to work to make his results perfect.	
Emma	-Interested in learning science -Confident in her abilities as a learner of science -Asked questions that demonstrated her application of science content -A science career was one option she was considering	-Emma used everyday language to make sense of the science content. This helped her to engage in the conversations and talk about science which she believed made her feel smart and was "cool" -At times when an adult was present, Emma's identity as a learner of science did not appear to be influenced as positively as when she engaged in peer conversations. When Mr. Crawford and Mrs. Roberts, the adult chaperones, dominated the conversations, Emma participated less often and it appeared to me that she did not enjoy the activities in these instances.	-Maintained interest in science and confidence in her abilities as a learner of science -The conversations helped others to see her a new ways -The science camp provided her with more information for considering a science career

		-Emma engaged with her peers in conversations which helped her to have fun while learning science and gave others an opportunity to see a new side of her personality. -Emma believed that the opportunity to learn science in the field kept her more engaged and would make the content "stick."	
Jordan	-Interested in science -A problem-solver in science -Jordan believed he was good at science and had confidence in his abilities as a learner of science -His teacher believed he had a "surface" confidence -He hoped to pursue a career in environmental engineering -He believed others saw him as a "nerd" or "geek" -Had sophisticated views of science	-Jordan commented that the opportunity to work in groups to complete the hands-on activities helped others to see him in a new way. -Jordan used language and came to align his discourse and practices with those of scientists. He developed skills in scientific argumentation and I observed him start to provide evidence to support his assertions. -Jordan used everyday language to make sense of the science content during the micro-organism lab. -Jordan felt that the hands-on and experience-based activities of the science camp helped he to enjoy science and influenced his	-Developed enthusiasm for participant in science learning activities -Deepened his confidence in his abilities as a learner of science -Maintained an interest in pursuing a career in science -Helped others to see him in new ways

		engagement in the science activities.	
Celeste	-Interested in science, specifically animal science -Confident in her skills as a learner of science verbally, but lacked confidence on written materials such as assignments and tests -Wanted to pursue a career in animal science	-Celeste described that she felt more comfortable in the science camp setting. She suggested that while working in groups, members learned from one another's mistakes, group members kept focused, the group conversations were fun. -Through conversations at the science camp, Celeste learned about new areas of science such as the environment. She suggested that this influenced her views of science and her interest in pursuing a science career. Instead of just focusing on animal science, she learned more about the environment while at the science camp. -Celeste viewed that the opportunity to engage in authentic science activities and to learn in the field helped her to see herself as a scientist. -The new figured world of the informal science camp may have influenced Celeste's participation. Although she noted that she was more	-Interested in new areas of science such as the environment -Disengaged from the activities at times -Extended her ideas about pursuing a science career -Developed social skills and was noted by her teachers as engaging in personal talk with her peers.

		enthusiastic about science, I noticed her disengage from the activities at times. One possibility is that she came to see science learning in a new way, a way in which she was still adjusting to.	

The case narratives that I detailed illustrate how the unique characteristics of the informal science education camp influenced participant's identities as learners of science (Table 7). Through the analysis process, the themes that surfaced as influential characteristics of the science camp included: supportive environment, focus on affective dimensions of learning, access to science tools, novelty, and authentic science. In this section, I detail each of these characteristics and summarize the findings from the case narratives that support these assertions. I list these categories by the evidence I have to support each assertion.

The supportive environment of the informal science education setting was one feature that appeared to influence participants' identities as learners of science. By supportive environment, I refer to the aspects of the science camp that helped participants in feeling comfortable to try on new identities as learners of science. In the informal science education setting, there was less of a focus on assessment and accountability. There were no quizzes, tests, or graded materials. Therefore, the learners could take risks in trying new roles and identities in a low-stakes environment. The informal science education camp had fewer constraints and procedures that are norms in the formal science classroom environment. For instance, there are no timed periods. The participants and educators can spend as much time in the environment as necessary without being rushed. There are fewer rules and procedures in the informal science education setting than in the science classroom.

That is, there was less of a focus on aspects of classroom management. For instance, participants could speak freely without waiting to be called on by the teacher. There were not strict procedures for turning in work or asking questions of the teacher. The norms in the science camp setting were different than in the classroom setting. In this way, the teachers and learners had more equitable roles. The teacher was not in the same position of power as a classroom manager, authoritarian or assessor. In some instances, the participants even had opportunities to engage in equitable conversations with their teachers. This shift in power provided a safe environment, one in which participants could reconsider their identity as a learner of science and try on new identities. Participants also had opportunities to engage with their peers. The case participants suggested that the opportunity to engage with peers during group work helped them to feel more comfortable and less under the microscope of the teacher.

The focus on affective dimensions of learning at the informal science education was a second characteristic that supported and reinforced participants' identities as learners of science. The MSC expressed as its mission to inspire and motivate students to learn science (MSC, 2010). The science activities at the science camp were developed to foster interest, enthusiasm, motivation and a sense of fun among participants. The case participants indicated that the science activities were fun and enjoyable. They had opportunities to collect organisms, engage in learning conversations with their friends, jump in the mud of the marsh, and wade through intertidal waters. The focus on fun facilitated their learning; participants were more focused and engaged in the activities because they viewed them as fun and enjoyable. In this way, the participants' identities as learners of science were developed with regard to their interest and motivation in science. They came to see themselves as the type of learner that enjoyed science and found it interesting. The case participants saw themselves as learners that were engaged in the experience-based and hands-on activities of the science camp. The increase engagement helped the participants to see themselves in new ways as learners of science.

A third way that the informal science education camp was influential was by providing participants with access to the tools of science, some of which are not necessarily available in the classroom context. Specifically, the MSC science camp program provided participants with access to tools including (but not limited to): research vessels, data collection instruments (e.g., refractometer, current cross, Van Dorn bottles, plankton nets), otter trawl nets, sieve boxes, and seining nets. The use of these authentic tools of science at the camp helped participants to try on the identity of a learner of science. These resources at the MSC helped the participants to see themselves in the role of scientist as they used tools of science. The tools served what Wenger (1998) referred to as boundary objects. The science tools helped to bridge the boundary between participants' communities and provide them with access to the community of science learners. The science tools also provided participants a way to engage in the periphery of science practices. They were able to have initial experiences with the community of science through access to the authentic tools of science. As the participants engaged with the science tools, they came to see themselves as learners of science.

Another aspect of the science camp program that influenced participants' identities as learners of science was novelty. The learning activities at the science camp were new and unique to the learners compared to those in the science classroom. The activities were new to participants and often took place in the field. Participants had opportunities to learn in the marsh, intertidal, and dune ecosystems, places where school science learning does not normally take place. They interacted with and collect organisms, activities that do not typically take place in school science. In some cases, such as on the Wallops Island dunes trip, the participants visited a secluded beach on which they would not have access outside of the field trip. The participants came to view these as experiences for which they do not normally have opportunities. The novelty factor sparked interest for learners and inspired their motivation to learn science. The novel experiences helped the learners to envision new identities as learners of science. They engaged in activities that were not familiar and were able to envision themselves in new ways. This aspect of novelty at the science camp helped to further influence participants' identities as learners of science.

A final characteristic of the science camp program that was influential was through the opportunity for learners to engage in authentic science. At the science camp, participants engaged in the real activities of scientists. They were not exclusively listening to lectures or reading textbooks but rather they were in the field, collecting authentic data. Participants engaged in conversations to negotiate scientific procedures, interpret data, and argue assertions. The experiments in the science camp context were authentic rather than the recipe-like experiments in the classroom where the outcome is pre-determined. The authentic science activities prompted participants to re-imagine what it meant to be a learner of science. Learning science was no longer framed in terms of answer teacher's questions correctly, memorizing facts, or performing on tests. Instead, science learning at the camp was about engaging in the authentic practices of scientists. This helped learners to see themselves in new ways with regard to their identities as learners of science. Additionally, learning in the field helped the participants to expand their views of science. They came to see science as situated in the real-world and not just a subject confined to schools. MSC educators provided stories about science in everyday life which shaped participants' views of science.

Table 7

Influential characteristics and identity resources of the informal science education camp.

Characteristics of Informal Science Education Camp Experience	**Description**	**Ways in which characteristics afforded benefits and change**	**Example**
Supportive Environment **Definition:** The lack of grading pressures, competition, rules and procedures created a safe environment for learners to try on new identities.	There was less of a focus on assessment at the informal science education camp. There was less accountability and fewer constraints such standardized tests and timed class periods. The teacher and learners had more equitable relationships. Thus, expertise was distributed among the teacher and learners. Participants worked in collaborative groups. The expectations in this setting were unique and different from the culture of schools. Both the teachers and learners had new roles. The routines, practices, and procedures were new in this setting (e.g., fewer rules, different classroom procedures).	The supportive setting helped participants to feel safe to try on new identities. They had an opportunity to work in a safe, low-stakes environment.	-Hannah was able to work equitably with a teacher to identify a seaweed species during the organism lab. -Dale felt more relaxed in the science camp setting because he felt less pressure. -Hannah felt more "comfortable" and "free" in this context. -Brynn commented that the science camp "opened her up."
Focus on Affective Dimensions of Learning	At informal science education contexts and at the science camp, the learning objectives focused on feelings,	Rennie (1994) suggested a focus on affect facilitates learning. The affective focus in	-The participants get to play in the marsh mud. They are encouraged to jump in the

Definition: Affective dimensions of learning emphasize such aspects as feeling, emotion, interest, enthusiasm and motivation.	emotions, and attitudes. The activities were fun, enjoyable, sparked participant’s interest and increased their motivation.	informal science education can increase motivational and engagement. The focus on interest, motivation, and enthusiasm can positively influence a participant’s identity as a learner of science.	puddles. The MSC educator asks all of the participants to jump in the marsh to notice its spongy quality. -Many of the participants commented that the science camp activities were fun and developed their interest in science. -Gretchen, on the marsh field experience, yells out, “OMG, that was amazing!” She commented that the marsh trip was so much fun, she wanted to have her next birthday party there.
Access to Science Tools **Definition:** The tools and equipment used by professional scientists for science investigations.	In the science camp setting, the participants had access to the authentic tools of scientists that they may not have access to in the school science classroom.	The opportunity to use the authentic tools of science guided participants and trying on an identity as a learner of science and seeing themselves as a scientist. The tools may serve as boundary objects to bridge communities of practice. That is, access to science tools may have provided a trajectory toward participation in the community of science.	-Participants attended a cruise on a research vessel. On the vessel, they had access to such tools as Van Dorn water sampling bottles, refractometers for testing salinity, secchi disks to test water turbidity and the current cross to measure current speed and direction.
Novelty **Definition:** The	The learning activities at the science camp provided novelty for	The new environment and activities may	-Hannah suggested that the dunes field experience to

opportunity to engage in learning experiences that are new and unique to learners. Opportunities that learners would not normally experience in the classroom.	participants. Some of the activities were new to the participants and they had the unique opportunity to learn in the field. The unique activities contrasted with the typical activities of school science.	positively influence participants' identities as learners of science. The novel setting can spark curiosity and inspire motivation. The novelty may help participants to see themselves in new ways.	Wallops Island was a novel and unique experience, one in which she may never have another opportunity for in her life. -Another novel aspect of the science camp was working with organisms. The chance to work with organisms is not something that ordinarily takes place in the science classroom. -Everett, Addison and Gretchen visit the aqua lab to see the green moray eel, Mo. They watch up close as Braeden feeds Mo. They excitedly ask questions about Mo and moray eels.
Authentic Science **Definition:** Learning activities that mirror the practices and contexts of practicing scientists. To "do science where scientists do science" (Barab & Hay, 2001, p. 6).	At the science camp, participants were engaged in the real work of scientists. Science was situated in the real-world context, participants learned about the importance of science in everyday life, and participants engaged in authentic experiments and inquiry practices.	The authentic science activities prompted participants to re-imagine what it meant to be a learner of science. Science was no longer about memorizing facts and following recipe-like experiments.	-Participants collected authentic science data on the research cruise. -MSC educators shared many stories that demonstrated the science in everyday life. For example, during the organism lab, Margot explained that carrageenan, an extract from seaweed, was used in chocolate milk as a stabilizer.

			-The participants learned in the field. They were able to apply what was learned in the classroom in the real-world during the field experiences.

The informal science education camp was influential in shaping and reinforcing participants' identities as learners of science. As their identities as learners of science were developed during the program, learning conversations played an important role. I viewed identity as socially constructed and developed through interactions with others. The participants used language to socially construct their identities as they interacted with one another. In the next section, I list the various ways in which language played a role in identity development at the MSC science camp (Table 8).

Sense-making practices. The participants used language to help them make sense of the science content at the science camp. Specifically, the participants used everyday language, gesturing and familiar activity structures. These ways of using language helped the participants to make sense of the scientific discourse and scaffolded their learning. Over time, they came to understand the terms and began appropriating scientific discourse. These sense-making practices helped the participants engage in science learning conversations which shaped their views of themselves as learners of science (Table 8). The participants also expressed that an understanding of the terms helped them to feel smart and they enjoyed being able to explain science topics to their teachers, peers, friends and family.

Positioning. Holland et al. (1998) and Polman (2010) suggested that identities are negotiated and that individuals position themselves and one another in relation to cultural norms. As individuals are repeatedly positioned, they come to be seen as belonging to a certain category. Participants in this study positioned themselves through the use of language (Table 8). Dale, for example, used the norms of the classroom to position himself as an "over-achiever" (pre-camp focus interview, May 2010). During the interview, he used language to position himself in this way within the norms of the classroom and compared to his fellow classmates. Brynn used language to position herself as the type of person that was not afraid to hold and interact with organisms. In the conversation with her peers during the lab, she used language to position herself in a way that was different than her peers who were afraid of the organisms.

Alignment. Wenger (1998) viewed one aspect of identity as aligning one's energy and activities to fit within the culture of a community of practice. In this study, I found that the learners aligned their practices with the community of science by appropriating scientific discourse, using scientific procedures and practices. The case participants used language as a means of alignment (Table 8). Language was used as learners began appropriating the discourse of science. They used language to discuss aligning their procedures with those of scientists. In some cases, the participants failed to align their practices with those of scientists and used language to express this as well. For example, at times the participants rejected using appropriate scientific procedures or resisted using goggles for fear of looking nerdy.

Engagement. The case participants repeatedly indicated that the opportunity to converse and talk with their friends helped them to feel focused and more engaged in the science learning activities (Table 8). They suggested that the opportunity to work with friends helped them have fun and made science interesting which resulted in increased engagement in the conversations and learning activities. Language, in this sense, was used to communicate with peers. As they conversed with one another, they had fun, made jokes, and talked about science in new ways. This helped them to find the science learning activities fun and engaging.

Power Dynamics. The use of language during the learning conversations helped the participants to re-negotiated power dynamics (Table 8). The opportunity to work in peer-peer groups that were equitable helped the participants to feel more comfortable and free to try on new identities. They remarked that when mistakes were made, accountability was spread throughout the group. Further, they felt less under the watch of the teacher when they were able to work in groups as compared to individually.

At times when they participated with educators, the conversations were more equitable. The teacher was not an assessor or evaluator in this setting, thus diminishing, to some extent, the power dynamic between the educator and learner. The opportunity to learn about their teachers on a personal level also helped the participants to feel more comfortable around their teachers. Brynn, for example, commented that she had an opportunity to learn more about her teachers by living on campus with them, socializing with them during leisure time and sharing meals. She suggested that this helped her to feel more comfortable around her teachers. Some of the learning conversations between the learners and educators were more equitable because both were in a position of not knowing the answer. In this way, the learner and educator were learning alongside one another. Finally, the language structure of the science camp did not always focus on triadic dialogue or teacher monologue, activity structures that Lemke (1990) suggested were used in the classroom by teachers to maintain power and control over their students. There were times during the science camp conversations where the learners had information that the teachers did not yet know. During these times, the teachers were asking questions to which the learners had the answers. These opportunities prompted a shift in power in which the learner and educators were participating in equitable conversations. Expertise was distributed among the participants and learners in these conversations. This aspect of the camp helped to foster a supportive environment in which participants could try on new identities as learners of science.

There were times during the science camp in which adults did exert power and control over the learners. During these times, the adults lead the activities and dominated the conversations. I noticed that in these situations, the learners did not feel as comfortable and did not appear to enjoy the activities as much. When adults exerted power during the conversations, the science camp activities had less of an influence on the participants' identities as learners of science.

Seeing Others in New Ways. A final way that learning conversations played a role in identity development as a learner of science was with regard to how the case participants perceived others viewed them (Table 8). The case participants suggested that the opportunity to engage in conversation helped them learn about one another, both on a personal level and with regard to their science learning. Language, in this sense, was used to communicate another side of the individual in a manner that would prompt others to see the participant in new ways. The learning conversations helped the participants show a wider range of their personalities and identities as learners of science.

Table 8

The role of learning conversations on participants' identity development as learners of science.

The role of language in learners' constructing identities as learners of science

Sense-making practices **Definition:** The act of making meaning of science content through social interactions with others. How someone comes to attribute meaning to a phenomenon that they experience.	-Brynn used everyday language to make sense of organism characteristics during the organism lab. The everyday terms helped her to understand the description in the field guide and appropriately identify rough tangleweed. -Emma used everyday language to help herself and her group members make sense of scientific terms such as “adipose fin” and “keel.” She was able to describe the features she saw and match them to the descriptions in the dichotomous key. This helped her to make sense of and use these terms.
Positioning **Definition:** The ways that individuals put themselves in categories relative to other in relation to cultural and social norms and practices.	-Dale used language to position himself as an “over-achiever” within the norms of the classroom. -Brynn used language to position herself as the type of person that would interact with and hold organism, a category that might be considered a norm for individuals working with animals in science fields. -In Addison and Gretchen’s group at the current cross station, the group used the compass incorrectly. When Lilly used the compass, she did it correctly and got an appropriate compass bearing reading. She makes a statement that they aren’t so smart. With this statement, she positions herself as someone that is smart and can appropriately complete the science activity. Lilly distances herself from the other group members who could not complete the task correctly and in doing so, attempts to position herself as someone that is smart at science.
Alignment **Definition:** Coordinating one’s energy and activities to fit within broader structures and contribute to the enterprise.	-The participants in all three school groups conversed about the need for repeating three trials during data collection. -Jordan used language to provide evidence for substantiating his assertions during scientific argumentation. During the organism lab, Jordan used language to provide evidence for his decisions in rejecting or accepting certain descriptions. When he checked his guess with Margot, he provided evidence to support his guesses. -At time during the organism lab, Brynn chose not to use the appropriate procedures for using the field guide to identify organisms. There were times when she looked at the pictures rather than going through the descriptions and weighing evidence as suggested in the guide. -While collecting water quality data, Addison, Everett, Gretchen

	and their group members use scientific terms such as, "Celsius," "Creosol read," "refractometer," "dissolved oxygen," and "density." They started to appropriate scientific discourse as a means to align their practices with those of scientists.
Engagement **Definition:** Active involvement in the process of negotiation of meaning. Our direct experience of the world and our active involvement with others.	-Jordan described that in the classroom, he sometimes found the lectures boring which resulted in his disengagement. In the science camp setting, he worked with friends and had fun which helped him to feel focused. The classroom teacher noted this change and suggested that he participated more often in the science camp activities. Jordan used language to discuss the content in ways that he viewed more fun than listening to a lecture in the classroom. -During the early activities of the science camp, Everett is quiet and stands back observing the group rather than participating in the activities. Throughout the program, Everett appeared to become more comfortable and confident by conversing with his peers in groups. He further commented that the activities were fun to participate in. As the camp continued, he started participating in the group conversations, getting more involved in the learning activities and even offering suggestions at time.
Power Dynamics **Definition:** The ways that individuals exert power and control over one another.	-Hannah suggested that in working with peers, she felt more "comfortable" which helped her to "open up" and take risks. She felt less confined and not always being watched by her teacher because the accountability was shared throughout the group. -While working to identify a fish species, Emma participated in an equitable conversation with her classroom science teacher, Ms. Tanner. Both Emma and Ms. Tanner did not know the correct identification for a fish that was collected in the field. They both struggled through the dichotomous key and the descriptions of the fish. As the group worked with Ms. Tanner, expertise was distributed among the learners and the teacher. This helped to diminish power relations between the teacher and learners. -In some cases, the adults exerted control of the conversation in ways that shut off communication and identity work within the group. On the research cruise, Mr. Crawford and Mrs. Roberts directed the data collection activities and dominated the conversation. The participants had less of a need to converse with one another to negotiate the procedures and data readings. Without opportunities to converse, their identities as learners of science did not seem to be positively influenced.
Seeing Others in New Ways **Definition:** Learning more about members of a community	-Jordan suggested that the learning conversations at the science camp helped him to show his peers another aspect of his identity as a learner of science. He believed that his engagement in the hands-on and field-based activities of the science camp would help others to see that he was not "afraid" to get involved. He believed others would come to see a wider range of his personality and identity as a learner of science. Instead of just

and developing new views of others.	seeing him as a "book learner," "nerd," or "science geek," they would come to see him as a learner of science who also enjoyed learning in a hands-on manner. -Emma indicated that by engaging in conversations with her peers, they would come to see her as less quiet and not just the girl that sits in the back corner asking questions.

At the MSC science camp, language played an important role in developing participants' identities as learners of science. As I went through the data collected, I noticed that several themes emerged with regard to how participants' identities as learners of science were developed at the MSC informal science education camp. The participants' identities as learners of science developed in the following areas: affective dimensions, alignment, views of science, science abilities, and career. I expand on each of these below.

I noticed development among participants with regard to affective dimensions of identities as learners of science. As a result of the science camp program, the participants developed in terms of their interest, engagement, and motivation to learn science. The participants suggested that they developed a greater interest to learn science through the hands-on, experience-based activities of the science camp. They learned to enjoy learning about science and described the activities as "fun." This resulted in their motivation to learn and increased engagement in the activities. The case participants became more involved in the learning activities and participated more often in the conversations and discussions.

By alignment, I noticed that the participants developed their identities in terms of engaging in scientific discourse and aligning their practices with those of scientists. Throughout the camp, learners used everyday language to make sense of the science content. As they made sense of the content, they were able to understand the scientific terminology. They understood the technical terminology and started to appropriate scientific discourse. The participants also came to align their practices with those of scientists. They were cautious of following the procedures appropriately such as when they made an effort to repeat trials at least three times as a scientist would. The participants' alignment demonstrated that they were developing in seeing themselves as learners of science.

Through learning conversations, the participants' identities as learners of science were shaped in terms of their views of science. Initially, some of the participants viewed science as a subject confined to schools. They did not feel that they needed science outside of the classroom and were unable to see science in their everyday life. As the science camp progressed, the learners developed their views of science. They expanded their definitions of science, believed they needed science outside of school, and saw connections to science in everyday life.

Another way that the participants' identities as learners of science developed was in terms of their perceived abilities in science. For some learners, the opportunities at the science camp helped them to gain confidence in their abilities as learners of science. On the other hand, some learners began the program with confidence in their abilities but the science camp helped to reinforce and deepen this confidence. The participants suggested that they felt more comfortable in the science camp context which helped to shape this confidence. Prior to the science camp, some of the learners framed their abilities in science within the world of school science. In this way, they lacked confidence in their abilities because they saw success in science as performance on tests, memorizing facts, and providing correct answers to teachers' questions. The informal science education camp prompted participants to redefine success in science which helped them to develop confidence in their abilities as a learner of science.

A final way in which the science camp influenced participants' identities as learners of science was with regard to career choices. Some of the participants came to see themselves as a learner who would pursue a career in science. Others began the program hoping to pursue a career in science and the science camp program helped them to maintain this interest. For several of the participants, the science camp helped to expand their ideas regarding a career in science. It provided them with more information about a science career and additional options. Additionally, the participants viewed that they had an opportunity to see a science career (marine science education) in person. By watching Jocelyn, Margot and Brant, they believed that they were able to witness a science career in action which further fostered their interest in pursuing a science career.

Group Identity

By group identity, I refer to one's sense of self derived from perceived membership in a social group. During group conversation in informal learning environments, group members learn about one another, members explore new roles within the group, new power relations play out and the group constructs shared meanings (Ellenbogen et al., 2007). Group identity is an important construct for learning. That is, an individual's perceived sense of self within the group may influence aspects of learning (e.g., ability to collaborate and learn from others, ability to see oneself as a capable learner).

Patriot Middle School. I present Patriot Middle School as an example to illustrate the ways in which the informal science camp program influenced a group's identity as learners of science. Brynn, Dale and Hannah attended the field trip program as 8th graders. All three were in the same science class at Patriot Middle School and often worked together during group activities at the MSC. Their experiences at the MSC demonstrated the ways in which a group's identity can be shaped and developed as part of an informal science education camp.

During the pre-camp focus group interview, Dale was very confident of himself and his abilities as a learner of science. Dale described himself as good at science, particularly with regard to memorization of facts. He stated in his initial journal entry: "I achieve exceptional grades in science…I am extremely confident in my [science] abilities" (Day 1 journal entry, May 2010). Brynn and Hannah commented that Dale was often called on in class by their teacher because he often knew the answers to questions or had his own questions to ask the teacher related to the materials. Dale believed he learned best through lectures and identified that he liked to have control during group work in class. He described himself in the science classroom as "an independent power keeper" suggesting that he preferred to work alone and tended to take control of group situations. Brynn and Hannah confirmed that Dale liked to take control of group situations and suggested that members of his group often checked with him to ensure they had the correct answers. At the science camp, Dale initially led and dominated group work during the early part of the program. Other group members were hesitant with their own work and would often consult Dale for his approval (field notes, May 2010).

Brynn and Hannah, on the other hand, both disliked science lectures and instead preferred experiments and hands-on activities. Both questioned their performance in science, which they believed was evidenced by the teacher not calling on them as often. Hannah described herself as "average" in science class (pre-camp focus interview, May 2010). She believed science was not always interesting and a difficult subject to grasp (Day 1 journal entry, May 2010). Brynn stated that "science is not my overall strength" (Day 1 journal entry, May 2010) They also both felt that they sometimes gave incorrect answers when called on in class. Both girls compared their performance to Dale's performance in science class as a means to gauge their science abilities (pre-camp focus interview, May 2010). For example, in discussing her abilities as a learner of science, Brynn commented, "I'm good at certain parts of science but unlike Dale I'm not really good at the whole memorization" (pre-camp focus interview, May 2010). Hannah also framed her view of herself as good in science in terms of Dale and his memorization skills. When asked how she views herself as a learner of science, Hannah stated,

> Umm. I find myself liking science and um, (•) I wouldn't say I'm the best at science, but I'm working for it, and I love to learn about it and I like (•) I'm not really good at memorization, so it's kind been a trouble, well not a trouble, but a problem this year. And, um, I'm hoping that next year, it'll, I'll get more interested in it, cause we're (all 3) moving on to honors bio. I'm really excited about that. (pre-camp focus interview, May 2010)

When I probed Hannah further to explain why she thought she wasn't "the best at science" she continued,

> Umm, mainly because this year I've found that we have to memorize a lot of terms and, um, formulas (•) and I'm good at the so-, solving the formulas, but is the memorizing and the setting it up that I have trouble with. (pre-camp focus interview, May 2010).

Both girls consider their abilities in science in terms of Dale's performance and in having the skill to memorize scientific facts.

During science activities early in the science camp program, both girls would lead various aspects of group work, but were always unconfident in their decisions and science content knowledge. This lack of confidence was evidenced by their checking with teachers and educators (research cruise field notes, May 2010; organism lab field notes, May 2010). Their science teacher further supported this notion during the pre-camp interview, suggesting that both Brynn and Hannah sometime lacked confidence with regard to their abilities in science (teacher interview).

Brynn, Dale, and Hannah interactions highlighted their initial pre-camp group identity. Dale seemed to dominate the group and was very confident and sure of his abilities as a learner of science. He self-described himself as a power-seeker and commented that he liked to control group work. Brynn and Hannah were less confident. They were often timid and quiet when giving responses during the pre-interview. Dale’s role in the group was often to take control of group learning activities. He saw himself as a leader and the most knowledgeable member of the group. Brynn and Hannah compared themselves to Dale, measuring their performance and abilities as learners of science relative to Dale. Brynn and Hannah indicated that Dale often had correct answers in the classroom while both of the girls saw themselves as less capable due to their sometimes incorrect answers. Further, both noticed that Dale was called on more often in science class.

As the science camp transpired, the group had many opportunities for interaction. These interactions helped develop the group’s identity, particularly with regard to developing new perceptions of self within the group, renegotiating power, taking on new roles, and learning more about other group members.

Prior to the science camp experience, Dale was confident in his science abilities while Brynn and Hannah both determined their abilities in science relative to Dale. Following the science camp experience, the students shifted their views of themselves and other members of the group. Specifically, Dale came to view other members of the group as more able in science than he originally perceived (post-camp focus interview, May 2010). Dale commented that he learned to trust other members of the group and relied on other students during science camp activities. He found that group members had information to offer and that he could learn from them through collaboration. For example, during the field experience to an intertidal ecosystem, Dale began asking questions of other group members, solicited feedback from his peers as to how to use the equipment, and divided up the tasks rather than trying to complete them on his own (field notes, May 2010).

Dale attributed this change to the diminished pressure he experienced at the science camp setting. He stated that he felt more "relaxed" and "calmed down" due to the lack of grading pressures. The atmosphere of the science camp setting, according to Dale, allowed him to trust other group members which resulted in his changing views and willingness to collaborate (post-camp focus interview, May 2010). In the classroom, Dale viewed science as getting the right answer, memorizing tasks, and performing on tests. The new setting of the informal science education camp prompted Dale to re-envision science. As a result, he came to see science learning as about more than memorizing facts and getting the right answer. Therefore, he developed greater confidence in his peers and learned collaboration skills.

In contrast, Brynn and Hannah shifted their views of themselves as members of the group and developed greater confidence in themselves. Following the experience, both Brynn and Hannah came to consider themselves as learners of science independent of Dale. During the pre-interview, they specifically gauged their ability relative to Dale's performance in the classroom. In the post-camp interview, they made no mention of Dale and instead talked about their abilities independent of other members of the group. Brynn commented that the science camp experience “opened her up a little bit” and made her feel more comfortable asking questions of others. Brynn’s shifting confidence was also evidenced throughout the interview. In the post-camp interview, she contributed more often, provided more in-depth answers, was more animated while giving responses, and at times jumped in first to answer a question (post-camp focus interview, May 2010). During science learning activities, she took leadership roles, volunteered to answer questions and participated more assertively. Likewise, Hannah indicated that she came to see herself as a more capable science learner. In her view, the informal science camp program encouraged her to “step out of [her] comfort zone” and to be more willing to take risks. Hannah believed that she felt more free in the science camp context and “not so confined to a tight classroom” (post-camp focus interview, May 2010). Hannah stated that this atmosphere allowed her to express herself more freely because she felt less pressure in the camp setting (Day 3 journal entry, May 2010; Day 4 journal entry, May 2010).

The group members recognized that they learned more about one another in the science camp context. Brynn pointed out that in their classroom setting there were not many opportunities for students to interact with one another. She stated, “in the classroom, I sit next to [Hannah] but we never really talk” (post-camp focus interview, May 2010). Brynn believed that she was able to learn more about her classmates and teachers in the science camp setting. She commented that in this setting, she was able to live with her peers in the dorms, eat all meals together with classmates and teachers, and get to know each other well at night during leisure activities. She stated that she “got to know the others so well” through the informal science camp experience. Dale echoed this notion and commented that the he was able to spend time and get to know his friends because there was less pressure in the science camp setting than at school. He continued and indicated that in school “the teachers are on your back telling you a specific work ethic" which Dale believed prevented him from learning about his peers. In the science camp setting, he felt less pressure to perform and more at ease to learn about his classmates and teachers.

The unique characteristics of the informal science education program molded the group's identity as learners of science. Informal science education programs are often non-formally assessed. The MSC does not grade students or rank them relative to one another. This lack of grading pressure influenced the group's identity, making them more comfortable to take risks and learn more about one another. Hannah, for instance, found that she was more "free" and "comfortable" in the science camp setting which influenced how she perceived herself as a learner of science relative to other members of the group. The interactive nature of the science camp program further influenced the group's identity. Students had opportunities to learn about one another through their social interactions in the science camp setting. As was the case with Dale, he learned the importance of collaboration as well as the need to rely on others during science learning activities. He specifically commented that he no longer was a power seeker and worked more equitably with group members at the end of the camp program. In this way, new power relations played out within the group. Dale no longer took control of learning activities but instead worked more equitably with his peers.

Thomas Jefferson Middle School. The case of Thomas Jefferson middle school group provided a second example of how group identity as learners of science was shaped through the learning conversations at the informal science education camp. Ellenbogen et al. (2007) posited that during group learning conversations in informal science education contexts, group members learn more about one another, explore new roles within the group, and renegotiate power relations. I saw evidence for two of these aspects of group identity with Thomas Jefferson Middle School: group members learning more about one another and exploring new roles within the group.

One example of how the group learned more about one another was demonstrated with Celeste's experiences at the science camp program. Celeste herself described that she talked more with her friends during the field trip program which helped them learn more about her. The classroom science teachers mentioned this development as well. In the post-camp interview they explained,

> Ms. Henry: I think, I think this experience, I think this experience has made her more confident in, maybe, um,…in terms of socially being around groups of people. Um, and I think this will, this will definitely come back in to the classroom. I feel like this has been definitely beneficial for her and I think, through this experience it may bring out more of her, more, um, of her in the classroom.
>
> Kelly: Can you elaborate more? You said you think it will translate to the classroom, can you talk more about how you think that's going to happen?
>
> Ms. Henry: I think maybe just from what I've seen her, cause she has been talking to people that she mentioned one of the students that she hadn't talked to since 5th grade. Um, and she's been, you know, interacting with them and I'm hoping that instead of just interacting with her group, she has a few people that she'll um, talk to in class and maybe (•) um, instead of just commenting, maybe bouncing off ideas in class or brainstorming in class, a partnering, when we do group work, maybe more, you know…more than what she had been doing.
>
> Ms. Tanner: Just the, the social part, I mean, I see her, she came out of her shell cause when I first met her a few days ago she was just quiet and you know, just didn't seem, now SHE just, is personable, um, you know, and I think that's gonna translate when we go back to school that, just the confidence, that, you know, 'this is something I got to do.' And, I hope she'll see that education is going to take her, hopefully out of her home situation. Not knowing exactly what that is, but knowing it's not the best. That maybe, ((clears her throat)) excuse me, this will give her the confidence that (•) you know, 'if I continue to work hard, then I'll get these opportunities again.'
>
> Ms. Henry: When I first, when she first got on the bus, she was sitting by herself cause she didn't talk to anybody the WHOLE way down. And then=
>
> Ms. Tanner: =Now we can't shut her up (laughs)=

> Ms. Henry: =yeah ((laughs.)) I was worried about her. And then, you know, I was trying to talk to her because I was behind her and then now she's just 'dah-, dah-, dah-' ((indicating that CC is chatty.))
>
> Ms. Henry: I think she will be more confident in terms of she's talked to me, she's mentioned to me the things that she hasn't had an opportunity to do and I feel like she=
>
> Kelly: =such as=
>
> Ms. Henry: =Just um, she talked about never having, you know, flown in a plane before. She had never gone to the beach before…Uh, but, you know, she hasn't had a lot of opportunities to do things, so…Um, more, definitely what I would, what I've seen is more talkative, um, maybe outside of, the actual, class. (post-camp teacher interview, May 2010)

The classroom science teacher's comments illustrated an aspect of group identity as a learner of science who developed at the science camp. At the MSC, Celeste had an opportunity to converse with her classmates and teachers. As a result, they learned more about Celeste and her personality. The classroom science teachers learned that she had never been on a plane before and also suggested later in the interview that Celeste had never been to the beach. They also learned more about her parents and information about her personal life. In this way, the group learned more about one another as they had opportunities to socialize and live together at the camp. Celeste provided one example for how the group came to know more about each member.

Jordan and Emma also echoed this idea of learning more about their group members. Both indicated that their peers may have misconceptions about them. Jordan indicated that his classmates might view him as a "nerd" or "book learner" (post-camp focus interview, May 2010). Similarly, Emma suggested that her classmates might perceive her as "quiet", a "book learner", or "the girl that sits in the corner asking questions" (post-camp focus interview, May 2010). Both believed that the science camp provided them with an opportunity for group work with their peers. They commented that the science camp gave them a chance to talk more and have fun with their peers. Living with their classmates in the dorms, eating meals with the group, and spending free time as a group afforded them time to interact with peers and learn more about one another. As a result, both believed that their classmates learned more about them and saw a wider range of their personality. Emma believed that others would see that should could be fun and wasn't just a quiet girl sitting in the corner (post-camp focus interview, May 2010). They would see that she was not just a book learner but could also learn and participate in hands-on learning activities. She was willing to as she stated, "get down and dirty" (post-camp focus interview, May 2010). Jordan likewise felt that others would see that he was not just a "book learner" or "afraid" to participate in the hands-on activities (post-camp focus interview, May 2010). Others would have a chance to see him in new ways and learn more about him.

Another aspect of group identity as a learner of science that Ellenbogen et al. (2007) indicated might change during learning conversations was that members would explore new roles within the group. The classroom science teachers noticed this aspect of group identity. In particular, the classroom science teachers noticed that Emma and Celeste participated less frequently than they commonly did in the classroom and that Jordan was more involved. Ms. Tanner believed that Jordan started to feel more comfortable in the science camp environment which prompted him to participate more often and take leadership roles during the learning activities. Jordan was observed leading the activities more often, particularly during the intertidal field experience that took place on the final day of the program. Jordan managed the learning tasks and offered suggestions which illustrated his increased participation and confidence. In this way, Jordan, Emma and Celeste negotiated new roles within the group. Jordan stepped up and shared leadership and participation with the other members of the group.

The Thomas Jefferson Middle School group illustrated how group identity as learners of science was fostered through learning conversations at the science camp. As learners engaged in conversations, they had opportunities for learning more about one another. Celeste was observed conversing more often with her group members which provided them a chance to learn more about Celeste. The group members lived together, shared meals together and spent their leisure time together. The group members talked with one another and engaged in hands-on activities during the program. For Emma and Jordan, they believed this helped others see a new side of them and change their views. The group identity as learners of science also developed in terms of exploring new roles within the group. Emma and Celeste were observed participating less often and Jordan was observed getting more involved. In this way, the group developed in a way that participation and leadership were shared among group members.

Brownsville Middle School. The case of Brownsville Middle School provided support for Ellenbogen et al.'s (2007) assertion that group identity develops with regard to new power dynamics playing out. This was particularly true for the case participants, Gretchen, Addison, and Everett as they engaged with other members of their school group.

Gretchen, Addison and Everett were 7th grade students from Brownsville Middle School. Gretchen and Addison were both white females; Everett was a white male student. These three case participants were often engaged in group work with two other members of the school group, Lilly and Kendall. During the early learning activities of the science camp, I observed Lilly and Kendall exerting control and power over their other group members. In particular, on the research cruise, Lilly and

Kendall dominated the group conversations and controlled the learning tasks (Research cruise field notes, May 2010).

This was illustrated at the physical observation station. The group was instructed to use the current cross, stopwatch and compass to determine the current speed and direction. Kendall and Lilly worked to complete all of the tasks of this station. Kendall was observed reading through the instructions and using the compass as Lilly dropped the current cross and noted the time. When it came time to record the data, Lilly and Kendall engaged in a debate with one another to determine the correct compass bearing and direction. Although other group members entered the conversation at times, Lilly and Kendall were primarily the ones conversing and completing the task.

> Kendall: Oh guys, when I did it (•) hold on. (•) I did (•) that was forty five.
> Lilly: [Wait, we need to go over this].
>
> Kendall: [Oh.] ((Kendall takes the compass and examines it more closely.))
>
> Madison: For this, time?
>
> ?: 45.
>
> Kendall: Okay. I think I did that wrong. So you went by the little thingy up there?
>
> Lilly: No, it's [??]. ((Kendall continues to examine the compass.))
>
> Addison: [??] ((The wind picks up and the tape becomes inaudible.))
>
> Lilly: [??]
>
> Kendall: I don't know.
>
> Lilly: Well let's just look at the opposites of each one of the degrees that we got so far. It's gotta be degrees of southwest instead of northeast.
>
> Dr. Miller (parent chaperone): Yeah.
>
> Kendall: Oh, okay.
>
> Lilly: Wow.

Kelly: Well, we can fix that.

Addison: So- ((The group members change their data with regard to current direction.))

Kendall: So we put southwest (and we don’t need degrees?)

Addison: I don’t think you do.

Kendall: So it’s just southwest.

Gretchen: Is that one still 130 though?

Lilly: Yeah, it would be 130…Alright, now are we finished?

Kendall: The average is gonna be one divided by [??]

Lilly: Man I wish we woulda done ((degrees)).

Madison: Yeah, this is the average.

Addison: It’s 43.6 repeating.

Kendall: For, for what.

Addison: For average.

Kendall: 43.6

Addison: Oh.

Lilly: So 43.6. Alright, what, the tidal current direction’s always southwest. Well, would you say southwest since it’s always southwest but we didn’t get the degrees because we’re not exactly smart?

Kendall: Is that a challenge, Lilly?

This episode exemplified the ways that Kendall and Lilly dominated the conversation. They contributed to the conversation more often and engaged in debate while the other group members, Gretchen, Addison, Everett, Madison, and Eva stood back and observed. Lilly positioned herself in this conversation as someone that was smart, thus attempting to exert power over her group members.

Later, while setting the Van Dorn bottles at the water sampling station, Kendall and Lilly again take control over the learning tasks. They completed the tasks by themselves and prevented the other group members from entering the conversation. When Braeden and the other adults encouraged the girls to let other group members participate, Kendall and Lilly jump in and take over the activities to maintain control of the group. In this way, they continued to exert power and control over the science activities.

Braeden: What are we doing at this station?

Kendall: We're using Van Dorn bottles.

Braeden: Alright, so, I have our Van Dorn bottles ((points)) down here and I already attached the safety line. So if you guys want to, ((gestures toward the bottles)) have at it. ((Lilly and Kendall jump in quickly before the other group members have the opportunity.))

Lilly: Okay. So. Alright, first we gotta set it. ((Lilly starts by grabbing the rope.))

Kendall: Okay. ((Looks in her field book for instructions.))

Lilly: Alright, so first we have to set it.

Kendall: Find the Mickey Mouse. ((As Lilly and Kendall set the bottles, the rest of the group observes in the background.))

Lilly: It's right up here. It's right here. ((Lilly picks up the bottle.)) So we gotta take the line.

Kendall: Attach the "L" to the cable.

Lilly: Here's the (L). ((Kendall steps up to help Lilly.))

Kendall: (And) the (zip guard).

Lilly: Um, I (have to attach it) with something.

Braeden: Let's get a couple of hands in there just to, uh, help out. It's kinda heavy and awkward to hold. ((Everett moves in to help, but Lilly motions with the bottle suggesting that she will do it by herself.))

Kendall: [??]

Lilly: (Maybe halfway in.)

Kendall: (I got it.)

Lilly: Wait, pacman clamp=

Kendall: =(How do you do it?)

Lilly: [??]

Addison: The line [??]

Kendall: (I didn't get that yet.)

Lilly: I don't see [??] ((Kendall starts to help Lilly with the line.))

Lilly: Wait, hold on.

Kendall: Alright.

Lilly: ((Let me just-)). Go ahead and put that [??] (Feeds the line through the bottle to Kendall.))

Kendall: Wait, um- ((Opens the field book and reads the directions.)) Attach the (cross).

Lilly: Alright, so. (Come on.) There we go. Okay. Now we got attach this ((holds up the line)) to…the bottom, sorry. ((Lilly continues to work with the bottle. Everett attempted to help but has takes it from his hand and is trying to hold it while attaching the clamps and feeding the lines through.))

Braeden: How are things going over here?

Lilly: ∨Good. ((Lilly says this under her breath.))

Braeden: I hear the confidence.

Kendall: Do you need help Lilly?

Lilly: Yeah. Can you hold this?

Braeden: Uh, here. ((Braeden walks over to help the girls.))

Everett: [??] ((Reaches over to start helping the girls. Braeden steps in to help.))

Braeden: So one thing is reattaching the "L". What you wanna make sure is that this pin here, (pulls it out) it's going to make it a lot easier…if you put this, um, wire in to the little groove.

Kendall: Cool.

Lilly: Okay.

Braeden: Okay, [??]. And you can see it's now, the pin, is coming in a tad closer to the cable. And once you have it on there, you can let go of the pin.

Addison: Now you can let go of the [??].

Lilly: Okay.

Braeden: And since it's tight on there. So it makes it a little bit easier.

Lilly: So. ((Lilly and Kendall take back over setting the bottle. Everett holds the bottle for them as they work on it.))

Kendall: Ready? ((Opens the field book and reads further.))

Lilly: Wait, is this, does this need to be opened? ((Lilly is referring to the plunger at the bottom of the bottle. The plunger should be opened to allow water to pass through freely until the correct depth is reached at which point the messenger will cause the plungers to release and close the bottle.))

Gretchen: Yeah.

Lilly: I think it does…No, I can't open it. I don't think it-

Kendall: Yeah, um, ((leans over and looks at the bottom of the bottle.)) Where?

Lilly: Here, undo that one.

Braeden: How's it lookin'?

Kendall: Huh?

Lilly: The bottom. From the bottom. ((Kendall works to undo the bottom plunger. Lilly intervenes.))

Lilly: Hold on. ((Lilly takes over and is able to undo the bottom plunger.))

Kendall: Lilly you're not saying [??]

Lilly: I know. Wait. My muscles are [??]. ((Kendall turns away from Lilly. Lilly was able to open the plunger after she took the bottle back from Kendall. She seems to be indicating that she was able to get the plunger off because she has more muscle than Kendall.))

Braeden: Wow, look at that. Way to go. It looks beautiful.

From this episode, I argue that Kendall and Lilly attempted to control the group activities. They rejected input and help from others and sought to complete the activities on their own. Kendall read the directions as Lilly completed the task of setting the bottles. When Everett motioned to help, Lilly took the bottle away from him as a means to continue controlling the activity. Even between the girls, there was a power struggle. When Kendall tried to help Lilly open the plungers, Lilly took the bottle away from Kendall and works to open it herself. The girls both wanted to be in a position of power to control the activities of the group. They dominated the conversation and activities while the other group members passively and silently observed.

As the science camp program progressed, the group members came to participate in more equitable ways. For instance, during the intertidal field experience which took place later in the program, Kendall and Lilly were observed contributing equally to the conversation and the activities. Other group members had opportunities to work with the sieve and offered suggestions. I present an episode of the group working with the sieve box to demonstrate how new power dynamics played out and the group came to contribute more equitably.

Gretchen: Everett. There it all goes.

Everett: Wait, oh, there’s a [??].

Gretchen: Eww. Oh, it’s just a shell.

?: Gross.

((Everett is holding the sieve box. Gretchen is still using the shovel. Addison is holding the glass jar for organism collection.))

Addison: This is going to go deeper and deeper.

Madison: Alright, [??]

Kendall: I hate it when it’s really [??]

Gretchen: Okay, I'm gonna jump on it. ((Gretchen is getting another shovelful of mud. She digs in the mud and then jumps on the shovel to get it to go deeper into the mud.)) Whoa. That did not work. ((She falls over to the side in the water.)) That did not really work. It really didn't and I'm going to break the shovel.

Addison: It's the pressure on it.

Gretchen: I got it. ((gasps)) Ah! Oh!

Kendall: OH:::H ((smacks her cheeks with her hands.))

((Gretchen lifts a shovel with a large sample of mud and adds it to the sieve.))

Kendall: ((Clapping for Gretchen.))

Gretchen: Watch us not get anything. Sorry Everett, there's [??]

Everett: Okay. ((Everett, Lilly, and Addison sift the mud with the sieve box. Eva, Kendall, and Madison move in closer to the box and observe.))

((The group members lean over the box and look. Some are helping to sift through the mud while the others observe.))

Kendall: Okay, we're good guys.

Lilly: Okay.

?: What are you doing?

?: Nothing.

Lilly: Wait, keep looking.

Kendall: Hey, Lilly, Lilly. Lilly, you grabbed [??]

Eva: ((yells out in annoyance over something touching her feet.))

?: Yeah.

Addison: Alright, hang on. Put it in the [??] ((Dips the collection jar and reaches it out toward the group. She seems to suggest that the group add the organism to the jar))

Gretchen: OH MY GOSH, it's like trying to eat.

Addison: Just pick it up. You don't need to be delicate. Just pick it up.

?: Yeah, it's like, it's like trying to get out.

Addison: He said he doesn’t want a snail of any kind but I’d rather see what it is.

Gretchen: Wait, that’s a crab.

Lilly: What?

Gretchen: It’s a crab. That’s not a snail.

Addison: I think this is a hermit crab you guys.

?: Do we put it in water?

Addison: I don’t know what it is. It’s got-

Lilly: Oh, it looks like we got the worm.

Addison: It’s like a baby.

Lilly: Wait, we can’t do like a worm. ((I think Lilly is concerned here about keeping the worm and crab in the same collection jar.))

Addison: Okay. We shouldn’t put it in here.

Lilly: Madison, put the worm in here.

Addison: Is it really bleeding?

Lilly: Internal worm bleeding.

((At this point, Gretchen has returned to digging with the shovel directly behind the group as they crowd around the sieve box.))

Lilly: It’s like really [??].

Kendall: It’s almost like (taking a nap already.)

Madison: Yeah.

Lilly: It’s going to the side. ((Lilly is holding the jar with the organisms and peering in to observe.))

Addison: OH NO, our snail’s gonna eat the worm!

Lilly: Oh no.

Addison: Look, it’s stopped too. It’s gonna eat it.

Lilly: Oh no.

Addison, Lilly, & Eva: OH:::H

Addison: Great job. ((Says in disappointment. I think she is upset that the crab is eating the worm.))

Madison: Wait, it's eating it?

Addison: Yeah, look, look.

Madison: EWW. ((laughs))

((All of the group members are leaning over the jar now and watching.))

Madison: NO:::O, OH MY GOD.

Kendall: OH MY GOD IT'S EATING THE WORM.

These contrasting episodes demonstrate how the group identity as learners of science developed over the science camp program, specifically in regard to new power dynamics playing out. At the beginning of the science camp, Kendall and Lilly dominated the conversation and exerted power over the group to take control of the learning tasks. This was particularly illustrated during the current cross and Van Dorn bottle activities on the research cruise. Kendall and Lilly directed all of the activities and dominated the conversation while the remaining group members stood back and observed them. However, as the science camp program progressed, the power dynamics played out within the group and members participated more equitably. From the sieving episode on the intertidal field trip, I assert that Kendall and Lilly learned to collaborate with others and share the learning tasks. The dialogue from this activity illustrated that Kendall and Lilly participated in the conversation equitably with other group members such as Addison and Gretchen. Other group members had an opportunity to handle the materials and learning tasks. Addison, Gretchen and Everett, for instance, were observed using the sieve box, shovel, and collection jar to complete the activities in the intertidal ecosystem. These episodes, I argue, represent how the power dynamics played out as the group identity as learners of science developed for Brownsville Middle School.

Summary. The data collected support the notion of group identity as learners of science developing through learning conversations in informal science education settings (Ellenbogen et al., 2007; The National Research Council, 2009). Ellenbogen et al. (2007) theorized that group identity would develop with regard to members learning more about one another, members taking up new roles, and power dynamics playing out. The case of Patriot Middle School demonstrated how group members derived their sense of self from perceived membership within the group. Initially, Brynn and Hannah framed their success in science in terms of school science. They compared themselves to Dale and believed they were not good in science. After the science camp program, they redefined their notions of success in science. This influenced their perceived membership in the group and both girls developed confidence in their abilities as learners of science. The case of Thomas Jefferson lends support to the notion of learning more about group members and taking on new roles. The case participants suggested that engaging in conversations with one another as well as the opportunity to live with their peers and teachers helped them to learn more about one another. The group members also took on new roles. Jordan, for instance, began acting as a leader during science activities, a role that for him was new. Finally, the case of Brownsville Middle School demonstrated how new power relations played out. Initially, Kendall and Lilly dominated the group conversations and exerted power over other group members to control the learning activities. This power dynamic shifted over the course of the science camp program and the group members came to participate more equitably in the learning tasks and conversations.

Chapter Summary

In this chapter, I provided six case narratives to exemplify the role of learning conversations in participants' identity development as a learner of science at the informal science education camp. The themes that emerged from my inspection and analysis of the data from the case participants suggested to me that the unique characteristics of the science camp context influenced participants' identities as learners of science. These features included: a supportive environment, a focus on affective dimensions of learning, access to science tools, learning in a novel environment, and participation in authentic science activities. The science camp developed and reinforced several aspects of an identity as a learner of science. Participants affective dimensions of identity developed, the aligned their practices and discourse with those of scientists, they broadened their views of science, they gained confidence in their abilities in science, and they were interested in pursuing science careers. The learning conversations played a role in developing these aspects of participants' identities as learners of science. Participants used language for sense-making practices, to position themselves in certain ways, to align their practices and discourse, to engage in learning activities with their peers, to negotiate new power roles, and to see others in new ways. I also described group identity as a learner of science and they ways that this was influenced by the science camp program.

Chapter 5: Discussion, Implications and Future Research

In this chapter, I review the theoretical framework of the study and engage in theory generation. For heuristic purposes, I discuss the insights outlined in chapter four as organized by the research question and sub-questions. I end the chapter and my dissertation report by stating implications of the study and by suggesting areas for future research.

Theoretical Framework

The central research question that guided this study was: What is the role of conversation in influencing participants' identity development as learners of science during an informal science education camp? I used the theory of identity development and situated this theory in science education to gain insight into this research question. I adopted Gee's (2001) definition in which identity is viewed as becoming and being recognized as a certain type of person. I was interested in investigating how language influenced identity development. Therefore, I felt it was appropriate to draw on the work of Gee (2001; 2005; 2011) as he work addresses discursive identity. Gee identified four aspects of identity: nature-identity, institution-identity, discourse-identity and affinity-identity. Because I was interested in the role of language in constructing an identity as a learner of science, I focused specifically on discursive identity. According to Gee (2001; 2005), discursive identity refers to individual traits recognized through discourse with other individuals. Gee (2005) argued that we use language to enact identity at the right time and in the right context to get recognized as a certain type of person. As situated in science education, Olitsky (2007) summarized that how students use science discourse and how they use talk with others to position themselves in the community of science can serve as indicators of students' identities as learners of science.

Wenger (1998) provided a theoretical model for conceptualizing communities of practice. The theory of communities of practices viewed learning as a social enterprise. An aspect of learning is becoming or what Wenger considered identity. Through social engagement, we talk about how learning changes who we are and creates personal histories of becoming in the context of our communities. Wenger listed three dimensions of a community of practice: mutual engagement, joint enterprise and shared repertoire. For a community of practice to form, members must mutually engage in actions whose meaning they negotiate with one another. Another characteristic of a community of practice was joint enterprise which Wenger defined as the set of goals or requirement for the practice negotiated by members of the community. Finally, Wenger identified a third dimension of a community of practice as shared repertoire which referred to the resources that facilitate the practice (e.g., tools, artifacts, definitions).

As a community of practice is formed, members engage with one another and come to recognize one another as participants in the practice. The practice necessitates the negotiation of ways of being a person in that community, what Wenger (1998) defined as identity. Wenger identified three distinct modes of belonging within a community of practice: engagement, imagination, and alignment. By engagement, Wenger referred to active involvement in the mutual process of negotiation of meaning. Imagination was defined by Wenger as creating images of the world and seeing connections through time and space by extrapolating from our own experiences. A third mode of belonging, alignment, suggested that as individuals, we coordinate our energies and activities to fit within the community of practice and contribute to the enterprise.

One characterization of identity that Wenger (1998) identified was nexus of multimembership. That is, we define who we are by how we reconcile various forms of membership into one identity. For middle school students, they must negotiate membership in several communities of practice including, but not limited to: their gender identity, their ethnic identity, their identity as an adolescent, their identity as a participant in school science, and their identity as a lifelong learner of science. Learners may perceive that certain communities of practice are in conflict and not amenable to connections. For example, Lemke (2001) suggested that certain approaches to science education are too masculine and may conflict with gendered identities. Aikenhead (2001) described that science teachers tend to teach a western view of science which he referred to as "scientism" (p. 337). Aikenhead characterized scientism as a view of science that is non-humanistic, objective, purely rational and empirical, universal, impersonal, socially sterile, and outside the influence of human bias, dogma, judgment or cultural values. In Aikenhead's theory, the view of scientism presented in school science was in conflict with students' cultural identities and alienated students from the community of science.

Wenger (1998) argued that as learners negotiate their membership in various communities of practice, they form different trajectories of full membership. Wenger posited that trajectories help to incorporate our past and our future in negotiating our present identities. One type of trajectory detailed by Wenger was that of a "boundary trajectory" which spans the boundaries between various communities of practice and helps to link these multiple communities.

Wenger (1998) postulated that boundary objects and brokers help to connect various communities of practice. Situated in learning science, a boundary object or broker might help to connect students' various communities of practice with those of science and learning science. In providing boundary objects (such as the tools of science) and brokers, informal science education may help in the brokering process as learners negotiate the many communities of practice to which they belong.

The theoretical framework articulated in chapter two served as a baseline for conceptualizing the study and analyzing the collected data. The initial identity as a learner of science model articulated in chapter two provided analytical direction for interpreting the collected data. However, Wenger's (1998) theory of identity, I argue, was lacking in several regards. In particular, I viewed that Wenger's theory of identity in a community of practice was lacking a mechanism to explain the brokering process. I theorize that language served as a mechanism to mediate the brokering process for my middle school student study participants at the informal science education camp as they engaged in learning conversations. Further, Wenger's theory only peripherally addressed issues of power. He identified that some trajectories can lead to marginalization and non-participation. However, he does not expand on this notion in his theoretical piece. In the next section, I engage in theory generation by discussing the role of language in developing identities as learners of science. I also explain contextual factors and how issues of power can influence the process of identity development as a learner of science. I argue that the findings of this study extend Wenger's theory.

The Role of Learning Conversations in Identity Development as Learners of Science

In this study, I explored the role that learning conversations played in influencing participants' identities as learners of science at an informal science education camp. I adopted Wenger's (1998) notion of multimembership and assumed that participants at the informal science education camp were members of multiple communities of practice (Figure 4). A particular tension that surfaced for participants was their multimembership as adolescents and school science students. The students expressed a tension between being viewed as a successful learner of school science and an adolescent. For instance, Dale explained that he achieved in school science but clarified that science was not his life. He continued and described that although he was successful in school science, he still had a social life and was popular with his friends (pre-camp focus interview, May 2010). Brynn also indicated that science was not her life. As a result, she believed that others may not see her as a learner of science (pre-camp focus interview, May 2010). Similarly, Emma and Jordan perceived that others may view them as "quiet," "a book learner," "nerd" or "science geek" because of their success and strong interest in learning science. This tension between being an adolescent and a member of the community of school science influenced the participants' identities.

Gee (2011) stated, "children acquire a secondary Discourse when they go to school that involves the identity of being a student of a certain kind and using certain kinds of 'school language.' This identity and these forms of language can, at points, conflict with the identities, values, and ways with words some children have learned at home as part of their primary Discourse. For other children there is a much better fit or match" (p. 180). Brown (2004; 2006) found that student participants in his study experienced this tension between their identities as African Americans and school science participants. In a study of students' discursive identities, Brown learned that students appropriated science discourse differentially. Some of the students in his study rejected the use of scientific discourse. Brown referred to this discursive identity as opposition status. For these students, using scientific discourse was in conflict with their identities as members of the African American community.

Brown's work demonstrated that for some students, their membership in multiple communities of practice can be in conflict. Students perceived that membership in one community would necessitate an abandonment of membership in another community. Identity development, in this case, required that students negotiate membership in various communities of practice to accomplish a nexus of multimembership.

The participants in the present study had to negotiate their membership in multiple communities of practice. The informal science education provided boundary objects in the brokering process to guide students on a trajectory of multimembership in their various communities of practice, including membership as both and adolescent and a learner of science. In his study of a school-aquarium partnership, Kisiel (2010) argued that informal science education institutions provide students with boundary objects and brokers for connecting communities of practice. Likewise, the MSC informal science education camp also provided boundary objects and brokers to guide participants in negotiating their various communities of practice.

The unique features of the informal science education camp provided boundary objects and brokers for participants to negotiate their various communities of practice. Wenger (1998) identified that physical entities such as science tools served as boundary object. Brokers were viewed as people that bridged the various boundaries between communities of practice. In this study, I take a broader view and argue that boundary objects and brokers are more than just physical objects and people. Instead, I view that there are several aspects of the informal science education program that bridged the boundaries between various communities of practice. In particular, analysis of the data collected in this study suggested the following features were influential on participants' identities as learners of science: focus on affective learning, access to science tools, supportive environment, authentic science activities, and novelty (Figure 4).

Schauble et al. (1996) pointed out that informal science education programs often have goals that differ from those of traditional school settings. Informal science education contexts focus on attitudes, engagement, and interest. Meredith, Fortner and Mullins (1997) defined affect as the area of education that focuses on the attitudinal and emotional development of students. Affective dimensions of learning emphasize such aspects as feeling, emotion, interest, enthusiasm and motivation. Anderson, Lucas, Ginns, and Dierking (2000), Meredith et al. (1997), and Tressel (2001) argued that informal science education settings place importance on affective dimensions of learning. Science camps in particular may seek to address participants' affective aspects of learning. Hymer (2005) and Fields (2007) indicated that science camps, as a goal, foster interest, enthusiasm and motivation for participants to learn science.

In this study, I found that the MSC informal science education camp similarly focused on fostering affective aspects of learning. The MSC stated as a goal to inspire and motivate participants to learn about marine ecosystems and the environment (MSC, 2010). The science learning activities during the camp program focused on providing participants with fun and motivating experiences that encouraged them to become interested in science. For example, on the marsh field experience, learners were encouraged to jump and play in the mud as a means to demonstrate that learning science could be fun. The participants, in their interviews, indicated that the activities helped them to see that science could be fun and prompted their interest to learn science. This focus on affective aspects of learning at the science camp positively influenced participants' identities as learners of science. The participants came to see science as fun and expressed an interest in engaging in science learning.

Falk and Dierking (2000) suggested that informal science education programs offer resources not necessarily available in school settings. I argue that the science camp program provided participants with access to science tools. Kisiel (2010) posited that informal science education settings can provide participants with access to science tools that may serve as boundary objects to connect communities of practice. Barab and Hay (2001) found that science camps can provided learners with science tools that they may not have access to in the classroom. At the MSC science camp, participants had access to tools such as a research vessel, organism collection tools, water sampling equipment, water quality testing kits, and physical oceanography observation equipment. These tools of science served as boundary objects to the community of science for the participants. The science tools provided participants with access to the community of science. In using the science tools, participants were able to see themselves working with the tools of science and imagine themselves as scientists. This feature of the science camp appeared to influence participants' identities as learners of science.

The science camp setting may have afforded participants with a supportive environment for considering new identities such as an identity as a learner of science. By supportive environment, I argue that the unique aspects of the science camp setting created a safe environment for learners to try on new identities. Hofstein and Rosenfeld (1996) identified one unique aspect of informal science education experiences was that they were non-assessed and non-competitive. Luehmann (2008) theorized that informal science education environments may provide more identity resources than school science by providing a supportive environment. According to Luehmann, teachers and learners have more equitable relations in informal science education environments. There are fewer rules and procedures in the informal science education setting. The unique characteristics of informal science education contexts, in Luehmann's view, creates learning situations that can encourage participants to try on a new identity, motivate participants to learn science, and provide participants with agency for taking control of their own learning and engagement in identity development.

I found that the MSC science camp program provided a supportive environment where participants felt safe to try on new identities as learners of science. The program provided an environment in which learners were not formally assessed or evaluated by their teachers or the MSC educators. This resulted in less competition between participants and fostered collaboration during group conversations. There were fewer rules and procedures in the science camp setting and learners were given opportunities to engage in equitable learning conversations with their peers and teachers. The lack of rigid procedures and rules as well as equitable conversations with teachers provided a safe environment for participants to try on an identity as a learner of science. Participants alluded to this aspect of the science camp during the focus group interviews and suggested that they felt comfortable in this setting and the experience opened them up. The participants were afforded agency in their learning which further enhanced their identity development as a learner of science.

Another aspect of the informal science education camp setting that was found to influence participants' identities as learners of science was participation in authentic science activities. Barab and Hay (2001) postulated that science camps may provide participants with the opportunity to engage in authentic science activities. They stated that participants have an opportunity to "do science where scientists do science" (p. 76). Participants work in the field and labs with tools used by scientists.

Similar to Barab and Hay (2001), I found that participants at the MSC science camp had opportunities to participate in authentic science activities. The participants were not exclusively sitting through lectures, memorizing facts or conducting recipe-like experiments with pre-determined outcomes. Instead, they were engaged in authentic science activities situated in the real-world context. For example, on the research cruise, participants were engaged in authentic data collection activities. They collected the same data that an oceanographer would collect such as water quality data and physical oceanography observations. These authentic science activities made science more meaningful and guided participants in viewing themselves as scientists.

The participants commented on this aspect of the informal science education camp. Dale stated during the post- camp interview that he learned to enjoy experimentation because he had no idea what to expect as an outcome. He contrasted this with experiments in the classroom in which the teacher knew what would happen and there was an anticipated outcome. Dale explained that this helped him to learn to enjoy experiments whereas before the science camp he preferred lectures and textbook learning. Hannah also mentioned the authentic aspect of the science activities at the camp. She referred to the activities as “interactive” and she believed she understood science better because she was “actually doing the activities” (post-camp focus interview, May 2010). Hannah believed that the science camp learning activities helped with her awareness of the actual experiments performed by scientists and opened her eyes to the true work of scientists (post-camp focus interview, May 2010). The authentic science activities helped participants gain an appreciation of the true work of scientists. Further, they were able to engage in these activities and try on the identity of a scientist.

A final theme that emerged from the data by result of my analysis in terms of influential aspects of the science camp was with regard to the novelty of the program. Anderson et al. (2000) theorized that informal science education contexts can provide participants with novel learning experiences. They investigated students on field trips to a science museum. Anderson et al. suggested visits to informal science education centers provide participants with an opportunity to experience phenomena and ideas that are new and novel to them. Falk, Martin, and Balling (1978) found that field trips to informal science education settings provided students with a novel setting for learning. Although both Anderson et al. (2000) and Falk et al. (1978) contended that the novelty interfered with learning, I found that it did positively influence participants' identities as learners of science.

I posit that the novelty of the informal science education camp motivated participants to engage in science learning. The participants suggested that the opportunity to learn in the field and participate in cooperative learning groups with their friends was a unique and novel aspect of the science camp environment. Participants indicated that the novel features of the informal science education camp helped them to see that science was fun and as a result, they had greater engagement and enthusiasm in the science learning activities. Participants such as Emma and Jordan believed the novelty of the hands-on and experiential activities of the science camp helped others to see them in new ways (post-camp focus interview, May 2010). Therefore, I suggest that the novelty of the science camp positively developed participants' identities as learners of science.

This finding connects with the work of Fienberg and Leinhardt (2001). Fienberg and Leinhardt speculated that a novel context might help to shape participant's identities as learners of history. They investigated learning conversations in a history museum and theorized that there are social dynamics such as turn taking, topic control, and social interactions that have been established by particular groups in their normative learning environments. Fienberg and Leinhardt stated that a novel situation, such as an experience at a history museum, might disrupt this balance and prompt learners to engage with one another in new ways. The novelty of the context might provide learners with an opportunity to explore new identities as they socially interact with their group in new ways. In this study, I found that the novel environment did prompt learners to try on new identities as learners of science. They socially interacted with one another in new ways in the novel context and participated in new activities. In the novel environment, participants were able to develop their identities as learners of science.

The unique features of the science camp setting helped to connect the boundaries of participants' various communities of practice. Although Wenger (1998) theorized that brokering was negotiated by physical boundary object or by individuals that serve as brokers, I extend this notion and argue that features of the informal science education camp can also aid in the brokering process. That is, in addition to access to science tools and authentic science activities, I contend that the other aspects of the informal science education camp (focus on affective dimensions of learning, supportive environment, and novelty) further support the brokering process.

Wenger's (1998) theory of communities of practice and the notion of brokering, I believed, lacked identificaton of possible mechanisms. The findings of this study demonstrate that use of language during learning conversations was a mechanism that supported the brokering process as participants bridge their various communities of practice to develop an identity as a learner of science. Language played a unique role in this process and was used by participants in several ways to negotiate their identities as learners of science. Specifically, participants used language to make sense of science content, position themselves within the community of practice, align their practices and discourse with those of scientists, engage in science activities, negotiate power dynamics and see others in new ways. In the next section, I expand on each of these aspects and discuss how language was used to support identity development as a learner of science at the science camp.

Lemke (1990) argued that science is a social process which requires communication. Science education, according to Lemke, is about learning the specialized language of science and using language as a system of resources for making meaning. Lemke offered the following explanation of talking science,

> When we talk science, we are helping to create, or re-create, a community of people who share certain beliefs and values. We communicate best with people who are already members of our own community: those who have learned to use language in the same ways that we do. When the people with whom we are trying communicate use language differently, use it in ways that make sense of a subject differently than we do, communication becomes more difficult. Science teachers belong to a community of people who already speak the language of science. Students, at least for a long time, do not. Teachers use that language to make sense of each topic in a particular way. Students use their own language to put together a view of the subject that can be very different. This is one reason why communicating science can be so difficult. We have to learn to see science teaching as a social process and to bring students, at least partially, into this community of people who *talk* science. (p. x)

This quote by Lemke underscores that teachers use language in a way that is unfamiliar to students. Lemke suggested that this may lead students to a different interpretation of science content than the teacher intended.

Scientific language, in Lemke's (1990) view, is a specialized way of using language. Science has certain stylistic norms such as passive voice, abstract nouns in place of verbs, and verbs of abstract relations in place of verbs of material action. Scientific language is universal and uses technical terms. Scientific language avoids personification, colloquial forms of language, metaphorical and figurative language, and references to fiction or fantasy. Lemke indicated that these aspect of scientific language resulted in a language that was dull and alienating for students. These aspects of scientific language also created a strong contrast between the language of human experience and the language of science.

Lemke (1990) posited that the specialized language of science and the ways teachers traditionally use language in the science classroom creates a "mystique" of science that can disenfranchise students (p. xi). Lemke stated, "That mystique tends to make science seem dogmatic, authoritarian, impersonal, and even inhuman to many students. It also portrays science as being much more difficult than it is, and scientists as being geniuses that students cannot identify with. It alienates students from science" (p. xi). In this way, the specialized language of science and the ways that it is traditionally used in school science can deter students' from developing an identity as a learner of science.

Lemke (1990) further argued that some teachers may use scientific language and activity structures as a means to maintain power in the science classroom. He identified that science dialogue has an organizational pattern or an "activity structure" (p. 98). Lemke defined an activity structure as a socially recognizable sequence of actions. There are specialized activity structures and everyday activity structures. Specialized activity structures are often technical and performed by specialists whereas everyday structures are ways of using language that are not technical such as talking on the phone, telling a story or writing a letter. Lemke suggested that teachers use certain activity structures as a way to exert power and maintain control in the classroom. For example, triadic dialogue is a specialized activity structure that is commonly used in the classroom. In this activity structure, the teacher has the power to dictate the question and evaluates the response of the student. The rules of triadic dialogue heavily favor the power of the teacher. Herrenkohl and Guerra (1998) use a different term and refer to this structure as IRE. They suggest that a pattern used in classrooms is one in which the teacher initiates a question, the student responds and the teacher evaluates. From this pattern of talk, Herrenkohl and Guerra derived the acronym IRE. They argued that IRE is a use of language that is foreign to students. In their everyday lives, it is rare that students would be asked a question by a speaker who already knows the answer. This use of language is unfamiliar to students and further distances them from the language of science. The use of specialized activity structures in the science classrooms such as triadic dialogue and IRE distances students from the language of science and may not enculture students' into the community of science learners.

Gallas (1995) echoed this view of scientific language and suggested that the way science language is used in the classroom may alienate some students. Science for those impacted students comes to be viewed by them as a field that is disconnected from their lives and a language in which they are not fluent. In this way, students come to the conclusion that they are not good in science. Gallas suggested that science discourse is exclusive and can be intimidating and difficult for students.

Science language relies on special structures that are distinct from students' everyday uses of language. Gallas argued that when a community of learners engages in the act of dialogue outside the influence of the teacher, conversations moves more naturally and toward an inclusive kind of talk about science in which everyone is included. In such conversations, language is meaningful and connected to the lives of students. Students bring their experiences to the dialogue and have agency in constructing scientific discourse.

I found that participants at the informal science education camp used language in new ways to make sense of science content that contrasted with the ways Lemke (1990) and Gallas (1995) suggested science language is used in schools. I observed students using everyday language and language structures with which they were familiar to make sense of the science content at the camp program. By everyday language, I mean that participants used non-technical terms to make sense of science content. Emma, for instance, used everyday terms such as "tiny" to make sense of the scientific term, adipose fin. Jordan used zooming noises and hand gestures to describe the features of plankton he was viewing in the microscope (Organism lab field notes, May 2010). In using these everyday terms and familiar structures of language, the participants used their personal experiences and meaningfully connected the scientific terminology to their everyday lives. They came to see science language as more familiar and connected to their lives as they constructed and eventually appropriated scientific discourse.

The participants used language structures with which they were familiar. Instead of activity structures such as triadic dialogue and teacher monologues, the participants engaged in equitable discussions with one another to negotiate the science activity procedures and to make meaning of the scientific information they were experiencing during the science camp. They were able to talk in their familiar, everyday language to make sense of the science content. Both the participants and MSC educators were observed using gestures to convey scientific information. As an example, Brynn motions with her hand to show how the plankton cilia were moving in the microscope. Through gesturing, Brynn was able to communicate in a way that she was familiar with which helped her to make sense of the scientific information (Organism lab field notes, May 2010).

I further observed the participants using language to personify the organisms. At times they named the organisms, referred to their “cuteness” and discussed their emotions or feelings. Dale and his group members, for example, named the snails that they collected during sieving on the intertidal field trip (Intertidal field notes, May 2010). Emma discussed how cute the plankton were that she observed under the microscope (Organism lab field notes, May 2010). Brynn described how cute and cool the crabs were during the organism lab (Organism lab field notes, May 2010). Jordan’s group discussed what the snails that they collected might have been thinking (Intertidal field notes, May 2010). This personification of organisms contrasts with normative uses of scientific language. In personifying the organisms, the participants were able to create connections with science and their everyday lives. They used their personal experiences to connect the organisms with their lives. Participants brought their experiences to the dialogue which made the content more meaningful to them. Using language in this way was less alienating to participants and influenced their development as learners of science. The learners saw themselves engaged in scientific discussions which positively influenced their identities as learners of science.

Learning conversations also played a role in participants’ identity development as they used language to position themselves relative to others within the community of practice. In their theory of identity, Holland et al. (2001) stated that individuals engage in social positioning as they negotiate their identities within cultural worlds. As individuals interact, they use language to position themselves in relation to others and to claim social position. Polman and Miller (2010) suggested that identities are dialogically negotiated within cultural contexts. As individuals socially interact, they position one another in relation to cultural norms and social categories. In this study, participants used language to position themselves and others as members in particular categories.

Participants such as Dale used language to position themselves relative to their classmates within the figured world of school science. Dale believed he was successful and would be considered by his peers and teacher as an over-achiever. When prompted to explain evidence for this characterization of himself, Dale explained that he had more prior knowledge than his classmates, sought to understand the content in greater depth than his peers, and asked more advanced questions than his peers (pre-camp focus interview, May 2010). As Dale described himself as a learner of science, he used language to position himself relative to other students. In his view of school science, Dale positioned himself in a category that was distinct from his peers. Dale viewed two categories of science learners: those that were good at science and those that were not. Through language and his comments during the interview, Dale positioned himself in the category of good at science.

A second example of positioning occurred during the organism lab. Brynn and her peers were discussing the action of touching and holding a hermit crab. Paula stated that she found the hermit crab “gross” and indicated that she was afraid to hold the crab. Brynn used language to position herself in contrast to Paula. She indicated that she was not afraid to hold the crab and suggested that Paula was overreacting by not wanting to interact with the organism (Organism lab field notes, May 2010). Brynn viewed that scientists would interact with organisms. Therefore, Brynn considered that there were two categories: those who would interact with organisms and those that would not. Brynn used language to position herself as a member of the category that would interact with the organisms and who were not afraid of the organisms.

These insights support the conclusions drawn by Mendick (2005). In her study of students' identities as learners of math, Mendick found that study participants positioned themselves during interviews in certain categories of being a learner of math. Through interviews with math students, Mendick learned that students constructed certain categories of being a math learner. For example, the student participants considered that one category was being either good or not good at math. Another category included being a math and science person versus being good at language and the arts. The students in Mendick's study positioned themselves in certain ways relative to these categories. In both Mendick's study and the present study, participants used language to position themselves in certain categories or communities relative to others.

Another way that participants used language to identify as a learner of science was to align their practices and discourse with those of scientists. Wenger (1998) referred to one mode of belonging within a community of practice as alignment. He defined alignment as coordinating one's energy and activities to fit within broader structures and contribute to the enterprise. Wenger provided examples of alignment, one of which was adopting scientific methods or certain discourses. Anderson (2007), in his study of math identity, added that enrolling in advanced courses would serve as an additional example of alignment. I combined both of these definitions and found that participants in this study aligned their practices with those of scientists by adopting scientific discourse, scientific procedures and methods, and planning to enroll in advanced coursework. Nasir (2002) suggested that as individuals engage in alignment, they identify as members of a community of practice.

In this study, participants used language for alignment to coordinate their discourse and actions with those of scientists as they came to identify as members of the community of science learners. Dale, for instance, used language to appropriate scientific discourse. He was observed throughout the science program using scientific terminology to illustrate his identity as a learner of science. On the research cruise, Emma was observed using scientific discourse to complete the data collection activities. She used scientific terms such as salinity, refractometer, density, and dissolved oxygen (Research cruise field notes, May 2010). The participants' appropriation of scientific discourse demonstrated that they were coming to identify as members of the community of science learners.

Another way that participants demonstrated alignment was with regard to their adoption of scientific practices. For example, the participants were observed aligning their practices to scientific methods. They used language to discuss appropriate procedures such as repeating data collection trials three times. As another instance of alignment, Jordan learned to engage appropriately in scientific argumentation. During the organism lab, Jordan aligned his practices with those of scientists by providing evidence to support his assertions and guesses during the identification procedures (Organism lab field notes, May 2010).

There were times when participants used language to resist alignment. This was particularly true for Brynn when she rejected the use of binomial nomenclature on the intertidal trip. Instead of recording the scientific name, *Spartina alterniflora*, for marsh grass as instructed, she asked Jocelyn if she could use the term “grass” (Intertidal field notes, May 2010). In a similar incident during the organism lab, Brynn expressed to her group that she was going to record an organism as “a crab” rather than work through the field guide to determine the appropriate species (Organism lab field notes, May 2010).

This study supports and extends the study detailed by Anderson (2007). Anderson found that one way students used alignment in mathematics was to enroll in advanced coursework. Participants in this study used alignment in this way and in additional ways. During the pre- and post-camp focus interviews, participants indicated that they intended to enroll in advanced science coursework. However, I found that they also aligned their practices in new ways that extend the findings of Anderson’s study. The case participants demonstrated alignment through the use of scientific discourse, scientific methods, and scientific argumentation.

The opportunity for participants to engage in learning conversations with their peers influenced their engagement in the science activities at the MSC science camp program. Wenger (1998) defined engagement as active involvement in the process of negotiation of meaning. Anderson (2007), in the context of mathematics education, identified engagement as our direct experience of the world and our active involvement with others. Anderson suggested that students’ view of mathematics learning has resulted from their engagement in school mathematics. In his study, he found that students came to see themselves as one who has or has not learned mathematics based on their engagement with mathematics in the classroom. Anderson argued that engagement in school mathematics resulted in students’ perceptions of themselves as having learned or not learned mathematics based on their abilities to get correct answers in the classroom.

Nasir (2002) further discussed engagement in a community of practice. Nasir defined engagement as how one participates in a community of practice. In her study of domino players, Nasir found that the nature of participants' engagement influenced how they identified as players. Nasir learned that as the nature of relationships between players shifted, their engagement in the practice of playing dominoes also shifted. As teammates and opponents developed relationships with one another as well as respect for their game play, they came to be able to expect a certain kind of play from one another. This influenced their engagement in the practice of domino play.

In this study, I found that the opportunity to engage in learning conversations shifted participants' engagement in the community of practice that is science learning. Like Anderson (2007), I found that participants initially framed their engagement in terms of school science. They perceived engagement in science as listening to lectures, taking notes, answering the teacher's questions, and responding correctly on tests and quizzes. This influenced how the participants viewed themselves in this community and influenced their engagement in the science learning activities.

The case participants indicated that the opportunities to converse and talk with their friends helped them to feel more comfortable in the science camp setting. Brynn and Hannah both suggested that they felt more comfortable and at ease in the group conversations at the camp (post-camp focus interview, May 2010). Everett was quiet and stood back observing the group during science activities rather than participating. As Everett appeared to get more comfortable in the science camp setting, he began to demonstrate increased engagement in the science learning activities. He started to converse, to some extent, with his peers and become more active in the science activities. Everett suggested that he would become bored and disengage when the learning activities weren't hands-on. He explained that the camp was field-based and hands-on which influenced his engagement in the activities (post-camp focus interview, May 2010). This finding connects with those of Gibson and Chase (2002) who found that participants of a science camp program reported that they remembered and most enjoyed the hands-on and inquiry-based science activities of the camp.

The case participants explained that the opportunity to work with friends helped them have fun and made science interesting which resulted in increased engagement in the conversations and learning activities. As the participants conversed with one another, they had fun, made jokes, and talked about science in new ways. This helped them to find the science learning activities fun and prompted their engagement in the activities. The participants learned more about one another and deepened their relationships. This further influenced their engagement in the science camp activities.

Language during the learning conversations was used to negotiate power dynamics. As Lemke (1990) described, teachers may use certain language activity structures (e.g., triadic dialogue and teacher monologues) in the classroom to exert power and maintain control over students. These language structures are different from the ways that students use language in their everyday lives and makes scientific discourse an alienating language for students.

At times during the science camp program, participants engaged in learning conversations in which power was diminished. Participants explained that working in peer-peer groups that were equitable helped them to feel more comfortable and supported them in trying on new identities. Case participants such as Hannah commented that they felt less under the watch of the teacher because expertise and accountability was spread throughout the group (post-camp focus interview, May 2010).

When participants engaged in exchanges with the educators and their teachers, it was sometimes in ways that differed from triadic dialogue and teacher monologues. Instead, they were able to participate in equitable conversations with their teachers in which power was distributed throughout the group. Hannah, for instance, engaged in a conversation with a teacher, Mrs. Carnetti, in which neither the teacher nor the participants knew the answer ahead of time. Hannah and Mrs. Carnetti were learning alongside one another in a mutual conversation (Organism lab, May 2010). This new balance of power provided a safe environment for the participants to try on and experiment with new identities as learners of science. This insight supports the assertions of Luehmann (2008). In a theoretical piece, Luehmann speculated that informal science education contexts might provide safe environments for participants to experiment with new identities as learners of science.

At times, adults did exert control over participants during conversations in which they dominated the activities and communication. On the research cruise, Mr. Crawford and Mrs. Roberts exerted control and power over participants' data collection activities. They dominated the conversation, directed participants through the activities, and prevented dialogue between the participants. Because the adults were answering all of the questions and directing the activities, there was no need for the participants to engage in conversations to negotiate the activities and meaning of the data readings. I noticed that in these situations, the learners did not feel as comfortable and did not appear to enjoy the activities as much (Research cruise field notes, May 2010). When adults exerted power during the conversations, the science camp activities had less of an influence on the participants' identities as learners of science.

These findings contrast with those of Crowley, Callanan, Jipson et al., 2001. In their study of learning conversations at children's museum, Crowley, Callanan, Jipson et al. found that children engaged more meaningfully at an exhibit with their parents than children that engaged the exhibit without their parents. They observed participants engage with a zoetrope animation device at a children's museum. Participants that engaged the exhibit with their parents were observed to participate in more talk than children that engaged alone or with a peer. I observed a different outcome during times when participants engaged in an activity with adults. As demonstrated by the exchange with Mr. Crawford and Mrs. Roberts on the research cruise, the adults directed all aspects of the activity and dominated the conversation. Participants had fewer opportunities for talk and did not converse with one another. Emma, in particular, participated only twice during the dialogue when the adults were present. In other activities when adults were not involved in the activities, Emma participated more than twice during the conversation (Research cruise field notes, May 2010).

A final way that language was used in identity development as a learner of science was in seeing others in new ways. The National Research Council (2009) speculated that during learning conversations, group members learn more about one another which influences how group members view each other as learners of science. The case participants in this study offered support for this assertion. They indicated that the opportunity to engage in conversations with their peers helped them to learn about one another and influenced how they came to see one another. The learning conversations helped the participants show a wider range of their personalities and identities as learners of science.

Dale presented one example of how engagement in learning conversations influenced how the participants viewed one another. He indicated that through collaborative group work at the science camp, he came to see others as capable in science. As his definition of science learning shifted, he viewed that his peers were equally as capable of learning science as himself. This new view of his peers helped Dale to learn the skills of collaboration. He commented that prior to the science camp, his peers would see him as a power keeper that liked to control the learning activities (post-camp focus interview, May 2010). This was evidenced in his attempt to control all of the procedures of the activities early in the science camp program. Dale would check behind his peers and trusted only his own data collection. Over the course of the science camp program, Dale came to see his peers in new ways and learned to trust their opinions and rely on their input during group activities.

Jordan and Emma also suggested that the learning conversations would help participants to see them in new ways. Jordan believed that his engagement in the hands-on and field-based activities of the science camp would help others to see that he was not just a book learner and was not afraid to get involved in the learning activities. He perceived that others would come to see him as a hands-on learner (post-camp focus interview, May 2010). In a parallel fashion, Emma believed that before the science camp program, her peers saw her as quiet and the girl that sits in the corner asking questions. Emma felt that engagement in group conversations helped others to see a wider range of her personality. She thought that others would come to see her as more talkative and willing to participate in the hands-on activities (post-camp focus interview, May 2010). These examples demonstrate how engagement in learning conversation prompted participants to see others in new ways.

The unique influences of the informal science education camp and the opportunity to engage in learning conversations helped to connect the boundaries of participants' various communities of practice. As participants were on trajectories toward full participation in the community of learners of science, their identities were influenced in several ways. In particular, participants' identities as learners of science developed in the following areas: affective dimensions, views of science, career considerations, confidence in abilities as a science learner, and alignment (Figure 4).

As a result of the science camp program, affective dimensions of participants' identities as learners of science developed. I viewed one aspect of an identity as a learner of science as interest, motivation and enthusiasm to engage in the practice of science learning. Carlone and Johnson (2007) similarly identified one aspect of an identity as a learner of science as the motivation to understand the world scientifically. I noticed development in this area among participants. The participants came to see themselves as more interested in science, enthusiastic about learning science, and motivated to understand the world scientifically.

There were many instances in which participants expressed that they were coming to see science as fun and they were motivated to learn about the world scientifically. The participants were observed commenting that something was "cool," "awesome," or "fun." For example, Regan commented on the research cruise that the refractometer was "so cool" (Research cruise field notes, May 2010). Brynn commented that the activities of the science camp helped her to view science as fun. She came to see that she could learn science while also having fun (post-camp focus interview, May 2010). Celeste explained that initially, she thought the marsh and the mud were “icky” but she learned to have fun in the marsh and enjoyed learning about the marsh after the science camp experience (post-camp focus interview, May 2010). Dale provided an example of how a learner could develop an interest in science as a result of engagement in the science camp program. He suggested during the pre-camp focus interview (May 2010) that he was not particularly interested in Earth science and specifically was not interested in learning about oceanography. Dale commented that the activities of the science camp program helped him to develop an interest in oceanography and marine science (post-camp focus interview, May 2010).

The participants suggested that they developed a greater interest to learn science through the hands-on, experience-based activities of the science camp. They learned to enjoy learning about science and described the activities as “fun.” Participants such as Emma and Jordan explained that it was “cooler” to have the opportunity to be outdoors and learn in the field (post-camp focus interview, May 2010). This resulted in their motivation to learn and increased engagement in the activities. The participants developed with regard to affective dimensions of their identities as learners of science. They came to view science learning as fun and were motivated and interested in learning about the world scientifically.

Participants’ identities as learners of science developed in regard to their alignment with the discourse and practices of science. As the science camp progressed, I observed the participants appropriating scientific discourse, using scientific methods, and engaging in scientific argumentation. The participants used everyday language to make sense of the science content which helped them to understand scientific terminology and appropriate scientific discourse. Participants also learned the procedures of scientists and began to align their practices with those of the scientific community. I observed the participants working to appropriately collect data, repeat trials three times, and wear safety goggles. Participants also exhibited alignment with regard to their skills in scientific argumentation; they learned to cite evidence to support their assertions.

This finding connects with the theory of identity in science detailed by Carlone and Johnson (2007). They suggested that individuals must engage in social performance to get recognized as a particular type of person enacting a certain identity. Situated in the community of science, they suggested that individuals must demonstrate fluency with science tools, all forms of scientific talk and scientific ways of acting. In doing so, an individual will be recognized by others as a "science person" (Carlone & Johnson, 2007, p. 1109). In the science camp setting, the participants used alignment to be recognized by others as a learner of science. Through "performance" of practices that aligned with those of scientists, participants were able to exhibit their developed identities as learners of science (Carlone & Johnson, 2007, p. 1109).

The informal science education camp positively influenced participants' identities as learner of science with regard to their views of science. Prior to the science camp, some of the participants such as Hannah viewed science as a subject confined to schools and did not see connections between science and everyday life (pre-camp focus interview, May 2010). They did not see a need to learn science other than for performance in school science. As the science camp progressed, the participants developed and expanded their views of science. They came to see connections with science to everyday life and believed that we needed science for technology and to address such problems as environmental crises. I speculate that the real-world context of the science camp as well as the stories shared by the MSC educators influenced participants' views of science. Learners had the opportunity to participate in science in the real-world which shaped their views of science. The MSC educators also shared many stories that highlighted connections with science in everyday life. For example, the MSC educators explained how the sassafras tree was once used to make a soda similar to root beer (Maritime forest field notes, May 2010). They explained how phytoplankton is present in such products as toothpaste and chocolate milk (Organism lab field notes, May 2010). These stories further shaped participants' views of science and they came to see connections between science and everyday life.

In mathematics education, Anderson (2007) posited that seeing how mathematics fits into everyday experiences was one example of what Wenger (1998) viewed as imagination. According to Wenger (1998), imagination refers to expanding our sense of self through time and space to create new relations and images of the world and ourselves. Wenger stated, "Through imagination, we can locate ourselves in the world and in history, and include in our identities other meanings, other possibilities, other perspectives. It is through imagination that we recognize our own experience as reflecting broader patterns, connections, and configurations" (p. 178). Anderson (2007) suggested that these images may include images of ourselves using mathematics in everyday lives. He added that if a learner does not see themselves as needing mathematics, they may develop an identity as one who does not need to learn mathematics outside of the school classroom setting. In the context of science education, a view of science in everyday life indicated that the participants saw a need to learn science and developed an identity as a learner who needs to learn science outside the classroom setting. In this way, they would develop an identity as a lifelong learner of science after they leave school science.

Participants' confidence in their abilities as science learners was another way in which identities as learners of science were positively shaped by the science camp program. In some cases, the participants gained confidence in their abilities as learners of science. For instance, Mr. Malone indicated that Brynn gained confidence as a result of the science camp activities (post-camp teacher interview, May 2010). Similarly, Ms. Tanner believed Jordan developed a deeper confidence through his participation in the science camp program (post-camp teacher interview, May 2010). On the other hand, some of the case participants already had confidence in their abilities as a learner of science and the science camp program helped to reinforce this confidence. Dale reported confidence in his abilities as a learner of science and his classroom science teacher, Mr. Malone, echoed this characterization and explained that Dale was very confident in his abilities as a learner of science (pre-camp focus interview, May 2010; pre-camp teacher interview, May 2010). This confidence was maintained and Dale reported continued confidence during the post-camp focus interview (May 2010).

Carlone and Johnson (2007) argued that one aspect of an identity in science is recognition. This recognition includes both self-recognition of one's abilities in science as well as recognition by others as having science abilities. In this study, confidence in science abilities was also considered one aspect of an identity as a learner of science. Case participants such as Brynn and Jordan came to recognize their own abilities as learners of science. These findings support the statements of Rennie (2007) who speculated that science camp programs may promote confidence in science. The findings also extend those of Markowitz (2004). Markowitz investigated the long-term impacts of participation in a science camp program by administering a survey instrument one to seven years after completion of the program. The data collected from this follow-up study lead Markowitz to conclude that the program influenced participants' perceived abilities in science.

This study extends the findings of Markowitz (2004) with regard to the influence of a science camp program on participants' confidence in their abilities as a learner of science. I similarly found that a science camp program developed participants' perceptions of their abilities to learn science. My use of a qualitative approach extends the findings of Markowitz and suggests how the science camp influenced participants' perceptions of their abilities to learn science. I found that participants indicated greater comfort in the science camp context which helped to shape their identities with regard to their abilities in science learning. The activities of the science camp were non-assessed and non-competitive and helped participants to feel comfortable as a learner of science in this setting. Participants suggested that the opportunity to work in groups at the science camp also influenced their comfort in this setting. By working in groups, participants felt that they were less under the watch of the teacher because accountability and expertise was distributed throughout the group. Another way that the science camp influenced confidence was through a re-conceptualization of success in science. Prior to the science camp, some of the learners framed their abilities in science within the world of school science. Thus, participants lacked confidence in their abilities because they saw success in science as performance on tests, memorizing facts, and providing correct answers to teachers' questions. After engaging in the science camp program, participants redefined success in science which helped them to develop confidence in their abilities as a learner of science.

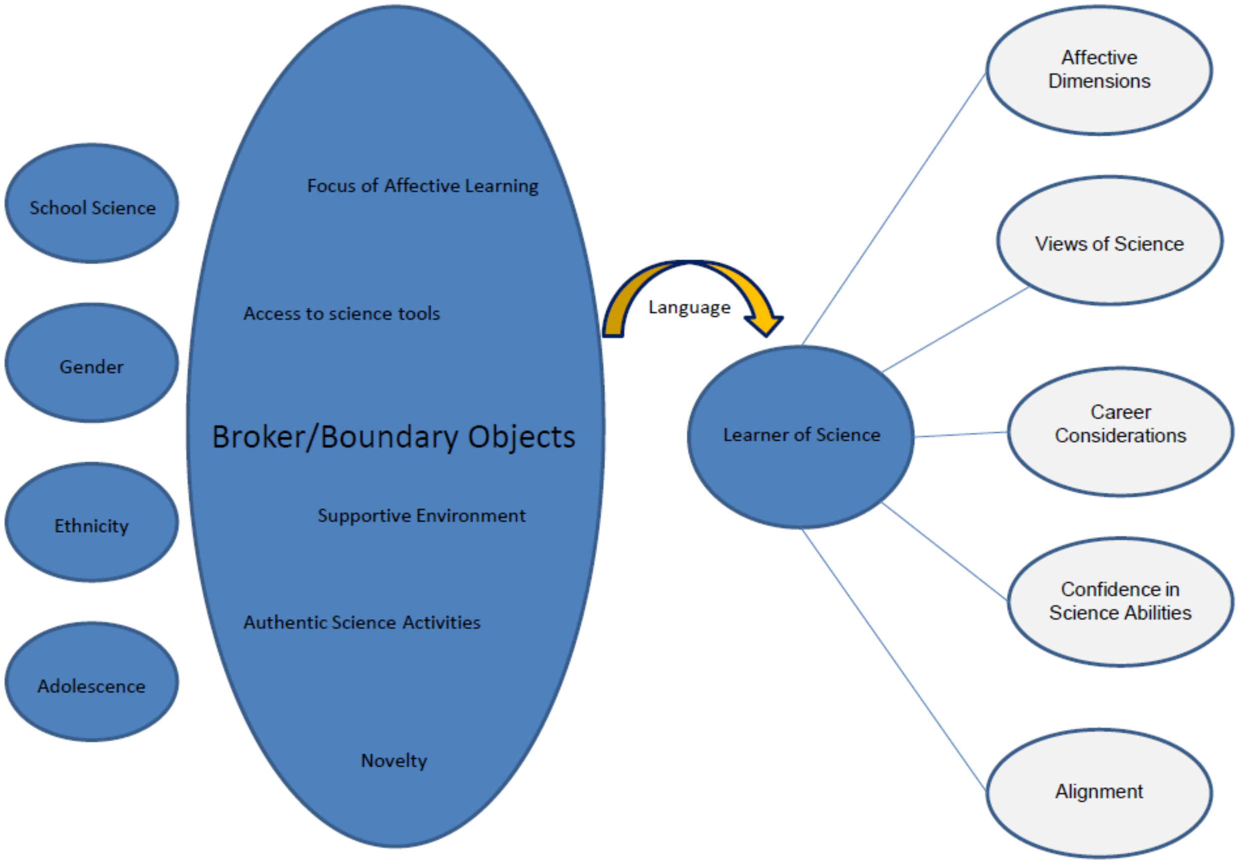
A final way in which the science camp influenced participants' identities as learners of science was with regard to their career choices. For some of the case participants, they began the science camp program already intending to pursue a career in science. Participants such as Dale, Jordan, and Addison hoped to pursue careers in science in areas such as human health and environmental engineering (pre-camp focus interviews, May 2010). The science camp program, in these cases, supported the participants' career choices. For other participants, the science camp program helped to extend their views of science as a career choice. Celeste, for instance, began the program wanting to pursue a career in animal science. Following the science camp, Celeste commented that she learned more about science careers and was also considering a potential career in environmental science. She suggested that the opportunity to experience a science career first hand by watching Margot as a marine science educator influenced her views (post-camp focus interview, May 2010). Emma indicated that science camp program provided her with more information about potential science career options (post-camp focus interview, May 2010).

Johnsen (1954) and Moore (2003) posited that adolescence is a time when individuals begin seriously considering career choices. They speculated that a science camp program might influence students' choice of pursuing a career in science. In this study, I also found that participants were beginning to consider future career options. Some of the case participants intended to pursue a career in science while for other participants, the science camp influenced their consideration of a career in science.

Summary of the Role of Conversation in Identity Development. The findings of this study build on theories of identity development as a learners of science. Figure 4 summarizes the theoretical model I developed from my insights in this study. Participants of the study had membership in multiple communities of practice which initially influenced their identities as learners of science. They belonged to various communities of practice based on their gender, ethnicity, and age.

Particularly notable in this study was the tension between participants' membership as an adolescent and their membership as a learner of science. Membership as an adolescent influenced their perceptions of self within the community of practice as a learner of science. The informal science education camp served as a boundary between these various communities of practice. The unique features of the science camp program helped to broker the process of connecting communities of practice to influence participants' trajectories as full members in the community of science learners. These unique features of the science camp program included a focus on affective dimensions of learning, access to science tools, a supportive environment, authentic science activities and novelty. The use of language during learning conversations served as a mechanism for the process of brokering the boundaries of various communities of practice. Participants engaged in learning conversations and used language in several ways to connect their communities of practice and develop their identities as learners of science. Language was used to develop an identity as a learner of science in the following ways: participants used language to make sense of science content, to position themselves in certain categories relative to others, to align their practices and discourse with those of the scientific community, to engage in science learning activities, to negotiate power dynamics and to see others in new ways. As participants used language during learning conversations, their identities as learners of science developed with regard to several areas. The affective dimensions of participants' identities as learners of science developed. Participants were interested, enthusiastic and motivated to learn about the world scientifically. They developed their views of science and came to see a need for science and connections with science in everyday life. The participants used alignment to connect their practices and discourses with those of the scientific community. Participants came to recognize themselves as having confidence in their abilities as a learner of science. Finally, the participants began to consider pursuing a career in science.

Figure 4. Model of the Role of Conversations in Identity Development as Learners of Science.



Group Identity as Learners of Science

Group identity is another area of identity that the National Research Council (2009) and Ellenbogen et al. (2007) speculated might develop through learning conversations in informal learning environments. The National Research Council (2009) and Ellenbogen et al. (2007) distinguished between group and individual identity and posited that both develop during learning conversations.

The construct of group identity comes from the field of social psychology. It has been applied to fields of study such as economics. Studies in economics have investigated how perceived group membership influences an individual's behaviors and actions (Ahmed, 2007; Chen & Li, 2009; Solow & Kirkwood, 2002). For the purposes of this study, I adopted a definition of group identity that came from such research in economics. Chen and Li (2009) defined group identity as one's sense of self derived from perceived membership in a social group. This notion contrasts with individual identity in which an individual is viewed as autonomous and independently motivated (Abrams & Hogg, 2004). Identity, in this view, is constructed from one's view of self. Group identity suggests that we are likely to derive a social identity from our perception of the group and our membership in the group.

Chen and Li (2009) defined a social group as two or more persons engaged in social interaction who have a relationship with one another, are interdependent, share common goals and perceive that they are part of the group. I considered that a community of science learners engaged in learning activities at a science camp would constitute a social group. The participants develop relationships with one another as they engage in the science learning activities together. The participants were interdependent; that is, they were mutually responsible to the group and shared a common set of activities and perspectives. They shared the common goal of engaging in and completing the activities of the science camp. In this way, the community of science learners at the informal science education camp constituted a social group.

Group identity has been posited to influence the action and behaviors of individuals that perceive membership in a particular social group (Ahmed, 2007; Chen & Li, 2009; Solow & Kirkwood, 2002). Once a person sees herself as part of a group, she derives self-esteem from group membership and aligns her behaviors with those associated with the group. Situated in the field of science education, once an individual identifies as a member of a group of science learners, she derives self-esteem from membership and will align her behaviors and actions with those of the group of science learners.

The National Research Council (2009) and Ellenbogen et al. (2007) have applied the construct of group identity to informal science education settings. They theorized that as participants in informal science education settings engage in learning conversations, individual and group identity as learners of science develops. In particular, Ellenbogen et al. (2007) suggested that during group conversations, group members learn about one another, explore new roles within the group, and new power relations play out as the group constructs shared meaning.

This study offered findings from empirical data to support the theories posited by the National Research Council and Ellenbogen et al (2007). The case of the Patriot Middle School group of learners suggested that individuals derived their sense of self as a learner of science relative to their membership in the group. In particular, Brynn and Hannah framed their identities as learners of science relative to Dale. Both perceived that they were not as successful in science as Dale. As evidence to support this idea, they described that they didn't get called on as often as Dale by the classroom science teacher and they believed their answers weren't correct as often as Dale's responses to the questions posed in the classroom (pre-camp focus interview, May 2010). After the science camp program, Brynn and Hannah re-conceptualized what it meant to succeed in science. As their definitions of science success shifted, they came to see themselves as members of the group of science learners. Their sense of self-esteem derived from this new view of themselves as member of this group.

I found that the groups developed in the ways that Ellenbogen et al. (2007) listed: the group members learned more about one another, explored new roles, and power relations played out. In terms of learning more about one another, the participants from the Patriot Middle School group suggested that the science and leisure activities of the science camp helped them to learn more about one another. The case participants from this group suggested that they had opportunities to talk with one another in groups, an aspect which they felt was lacking in their school science environment. As they engaged in conversation and had fun with one another during the activities, they learned more about one another and saw a wider range of one another's personalities (post-camp focus interview, May 2010). Mr. Malone, the classroom science teacher, explained that he was able to see a broader range of Dale's personality at the science camp (post-camp teacher interview, May 2010). Brynn suggested that the opportunity to live with her peers and teachers as well as eat meals together and share leisure activities day to day helped her to learn more about others (post-camp focus interview, May 2010).

Likewise, the Thomas Jefferson Middle school group learned more about one another throughout the science camp program. Ms. Henry described, for instance, that she viewed a new and more outgoing side of Celeste's personality. She indicated that she observed Celeste talking more often and engaging in conversations with students she hadn't spoken to in a while. Ms. Henry explained that she learned more about Celeste's family and her prior experiences (post-camp teacher interview, May 2010). Celeste also described that she had an opportunity to learn more about others and was able to share a new side of her personality with her peers. She suggested that she had fun talking with her peers during the science activities and in the dorms as she lived with her peers (post-camp focus interview, May 2010). Jordan and Emma both believed that others came to learn more about them through the course of the science camp program. As they participated in the activities of the program, they believed that others saw other aspects of their personalities. They believed that others would learn to see them as not just quiet or a book learner. Emma suggested that others would see that she was fun and could make jokes. Jordan felt others would see him as a hands-on learner and not just a book learner (post-camp focus interview, May 2010).

As Ellenbogen et al. (2007) speculated, the members explored new roles within the group. With Patriot Middle School, Dale learned to relinquish control of the learning activities and engaged in collaboration with his fellow group members. In doing so, he learned that there were times when other members of the group could take a leadership role to guide the science activities (post-camp focus interview, May 2010). With the case of Thomas Jefferson Middle School, Jordan developed his confidence which resulted in his exploration of leadership roles. At the beginning of the science camp, Jordan would let others lead and direct the learning tasks. As the science camp progressed, Jordan explored leadership roles within the group. For example, on the intertidal field experience, I observed Jordan directing the activities, assigning tasks and offering suggestions (Intertidal field notes, May 2010). I believed this was evidence that he was exploring a new role within the group, specifically a leadership role during the science activities.

The case of Brownsville Middle school supported Ellenbogen et al.'s (2007) notion of new power relations developing within the group. The case participants Addison, Gretchen and Everett often worked in collaborative groups with two of their peers, Lilly and Kendall.

At the beginning of the science camp, Lilly and Kendall dominated the science activities. They directed all aspects of the group activities and took control of the group. On the research cruise, for instance, Kendall read through the instruction while Lilly followed the instructions to carry out all of the data collection activities. The other members of the group were not involved with any of the aspects of the data collection. Instead, they stood behind Lilly and Kendall and observed as the two girls took control of the learning activities (Research cruise field notes, May 2010). As the science camp progressed, new power relations played out. The members of the group engaged in learning conversations and as a result, the power relations shifted in a way that the learners began to contribute equitably to the science learning activities. Lilly and Kendall shared the responsibility with their fellow group members when carrying out the science activities. I observed Addison, Gretchen and Everett becoming more involved in the activities with Lilly and Kendall and sharing the responsibilities of the learning tasks. This example of Brownsville Middle school demonstrated that new power relations was one aspect of group identity that developed during learning conversations at the informal science education camp.

Summary of Group Identity. The findings of this study lend support to the assertions of the National Research Council (2009) and Ellenbogen et al. (2007). I found that the group identity as a learners of science developed in the ways theorized by Ellenbogen et al. (2007). Members of the group learned more about one another, took up new roles within the group and negotiated power relations. Group identity is an important construct for learning. That is, an individual's perceived sense of self within the group may influence aspects of learning (e.g., ability to collaborate and learn from others, ability to see oneself as a capable learner). Ahmed (2007), Chen and Li (2009) and Solow and Kirkwood (2002) found that perceived group membership drove individuals' decision making, behaviors and actions. The learners' membership within the community of science learners may guide their behaviors and actions. A future area of study would be to investigate how learners new perception of membership within the group guides these aspects of group identity.

Discussion

The insights from this study build on previous research in several areas of inquiry. First, this study extends theories of identity specifically with regard to discursive identity and group identity. This study also adds to the literature on learning conversations, particularly research on peer-peer conversations. Finally, it builds on research related to learning in informal science education contexts such as science camp programs.

Discursive Identity. The theory of discursive identity suggests that identity is socially negotiated through language. Gee (2001) defined discursive identity as individual traits recognized through discourse during social interactions. Gee (2001; 2005) argued that we use discourse to enact identity at the right time and in the right context to get recognized as a certain type of person.

There are few studies situated in the context of science education that explored discursive identities. Brown's (2004; 2006) work provided initial insights as to students' discursive identities as learners of science. Brown (2004; 2006) learned that students in the science classroom adopted four different levels of discursive identities. One discursive identity that Brown (2004) identified was that of opposition status. Brown (2004) learned that students in the opposition status rejected the appropriation of scientific discourse. For these students, the discourse of science was perceived as in conflict with their cultural backgrounds. These students believed that adopting scientific discourse would require abandoning their cultural identities. The findings from Brown's (2004; 2006) studies had implications for marginalized students in science education classrooms.

The insights from this study build on the research related to discursive identities in science education. Like Brown (2004; 2006), I found that one aspect of participants' discursive identities as learners of science was appropriation of science discourse. Additionally, I found that participants' at the informal science education program used language in other ways to build their identities as learners of science. Participants used discourse during learning conversations in additional ways such as to make sense of science content, to position themselves within the community of practice, to engage in the learning activities, to negotiate power dynamics and to see others in new ways.

Group Identity. This study builds on another area of the literature on identity and extends theories of group identity. Previously, research on group identity has been situated in areas such as social psychology and economics. The National Research Council (2009) and Ellenbogen et al. (2007) applied this notion of group identity to learning in informal science education settings. Both theorized that group identity might develop during learning conversations in these contexts.

My findings from this study provide an empirical basis for understanding group identity as learners of science. The data collected from group learning conversations at the informal science education lend support to the assertions detailed by Ellenbogen et al. (2007). This study provides evidence that group identity as learners of science developed in the following areas: group members learned more about one another, members took up new roles within the group, and power relations were negotiated.

Learning Conversations. This study of learning conversations between peers at a science camp program addresses several gaps in the research literature. As explained in chapter two, the research on informal science education has primarily looked at learning conversations in the context of museum-like settings. Crowley, Callanan, Jipson et al. 2001), for example, explored learning conversations in the context of a children's museum. Allen (2002) investigated learning conversations at *The Exploratorium,* a science center. Similarly, Zimmerman et al. (2009) also explored learning conversations in a science center context. Studies that investigated learning conversations in new contexts such as science camp settings were lacking in the research literature. This study adds insights from a science camp setting. The findings demonstrate how learning conversations transpired in the new context of the science camp. One aspects of the science context that uniquely influenced learning conversations was the field-based nature of the activities. Learning conversations in the science camp setting included talk about learning outdoors and the ways that field-based learning influenced participants' identities as learners of science.

In addition, much of the literature on learning conversations in informal science education settings has focused on the nature of family conversations and adult-child interactions. (Ash, 2003; Crowley, Callanan, Jipson et al., 2001; Ellenbogen, 2002; Zimmerman et al., 2009). The findings from research on family conversations suggested that families interact socially in informal science education environments to jointly construct meanings of the content presented in exhibits. Family members have shared experiences, beliefs and values that influenced the meaning making process (Ellenbogen, 2002). Adult-child interactions from these studies of family conversations argued that parents assist children's scientific reasoning, explanations and engagement with the exhibits (Ash, 2003; Crowley, Callanan, Jipson et al., 2001). Crowley, Callanan, Jipson et al. (2001) found that parents scaffolded the museum visit experience for children by encouraging talk, helping children select and encode relevant information, and generate scientific evidence. These findings from family learning conversations provided a baseline for understanding learning conversations in informal science education environments.

However, studies investigating learning conversations between peers were lacking. Astor-Jack et al. (2007) called for similar studies that investigated learning conversations between peers.

Rogoff (1998) suggested that collaboration between peers would lead to more equitable conversations. I posited that the equitable relations during peer-peer learning conversations would create a supportive environment, one in which participants would feel comfortable to try on new identities as learners of science. The insights gained from this study support this contention. The participants reported feeling more comfortable in group conversations with their peers. They indicated that they were less under the watch of teachers and less accountable because responsibility was distributed throughout the group. These insights add to the literature on learning conversations. This study explored learning conversations between peers and found that they were distinct from those between adults and children, particularly with regard to the influence of power on learning conversations.

The conversations between adults and learners at the science camp also add to the literature on learning conversations. The insights from this study, in some ways, contrast with the findings of research on adult-child conversations. For instance, Crowley, Callanan, Jipson et al. (2001) reported that children engaged more meaningfully with exhibits when an adult was present to scaffold their learning. My findings contrasted with those of Crowley, Callanan, Jipson et al. I found that at times, adults dominated the conversations and controlled learning activities in ways that interfered with science learning and identity development. As the adults took control of the conversations, participants were observed talking less often and did not have a need to converse to negotiate the procedures and meaning of the data collected. Further, they appeared to enjoy the science activities less when the adults dominated the conversations. That is, when adults were not present, participants shared stories, jokes and analogies to understand the science content. However, when an adult was present, they did not engage in this way while conversing with one another.

Informal Science Education Camps. This study extends research on learning in informal science education camps. Previous research on learning in informal science education settings has focused on museums and science centers. Schauble et al. (1996) argued that other informal science education settings have been understudied or ignored. Dierking et al. (2003) suggested that although data from museum studies can serve as a baseline for understanding learning in other informal science education contexts, comparable studies in venues such as science camps were still needed. Science camp settings have characteristics that are distinct from other informal science education settings and as such, a study of a science camp setting was warranted.

Previous research on science camp settings relied on quantitative instruments such as questionnaires and surveys to assess the outcomes of these programs. Stevens et al. (2007), for example, administered a survey to assess the influence of a science camp on participants' attitudes and found that over 90% of the participants maintained a positive attitude toward science after the program. Gibson and Chase (2002) administered two quantitative surveys and concluded that participants of a science camp program maintained positive attitudes and greater interest in science careers than non-participants. Likewise, Markowitz (2004) examined long-term gains of a different science camp program by administering a survey to participants one to seven years after they completed a science camp program. They found that the science camp program positively influenced participants' perceived abilities in science, participation in extracurricular science activities, and interest in pursuing a science career.

Although these quantitative studies of science camp programs provided an initial understanding of this context, they failed to take an in-depth look at how such programs influence aspects of participants' identities. This study builds on the literature related to science camps by using case study methodology to provide a rich, thick description of the science camp context. By providing a descriptive account of a case of a science camp, this research provides insights into how a science camp program influenced aspects of participants' identities as learners of science in relation to the outcomes reported in the previous studies mentioned. The description of the science camp provided an understanding of how the science camp context influenced participants' attitudes, interest in science and pursuit of a science career as mentioned in previous studies.

Summary. In this section, I demonstrated how the findings from my study build on and extended previous research in science education. Specifically, my research adds to literature on identity development in science, learning conversations in science education contexts, and informal science education camp learning environments. With regard to identity, the insights from this study add to the literature on discursive identity. Further, this study adds empirical evidence to support assertions detailed by Ellenbogen et al. (2007) about group identity as learners of science. My study builds on the learning conversation literature by examining peer-peer conversations in the new context of science camps. Finally, the findings of my study extend the literature on science camps through a qualitative approach that provides a rich, detailed description of a case of a science camp program.

Implications

I believe that the rigor of my study and the conclusions drawn can have implications for other science educators, particularly those in informal science education environments. Although my study is limited by being a single case study, I think my insights add to research on science camps and learning conversations. I do not claim that the insights of this study are universally applicable nor do I contend that the same results would happen in a different setting, context or with different participants. However, I do argue that there are some aspects of this study that have broader implications for science education and particularly informal science education.

First, an implication of this study relates to the design of science camp programs. The findings of this study offer aspects of a science camp program that support identity development as learners of science for participants. Designers of science camp programs should create opportunities for participants to engage in group learning conversations during the science learning activities. In this way, participants would have ample opportunities to engage in equitable conversation with their peers. The desired result of such in group learning conversation would go beyond encouraging engagement in science. The learning conversations would foster positive identity development in science.

A second implication would be to develop science activities that use language activity structures that do not include triadic dialogue or teacher monologues. Although the science camp provided many opportunities for participants to engage in group learning conversations, there were still times when MSC educators used triadic dialogue and teacher monologue. Specifically, most of the science camp activities began with a lecture back at the MSC campus. These lectures ranged from 15 minutes to three hours. During the longer lectures, participants reported feeling bored. I further observed participants disengaging from the activities as evidenced by their falling asleep, talking with one another and looking around the room. There were also times when MSC educators used triadic dialogue to prompt recall of the information presented in the lectures. I argue that these uses of language did not foster positive attitudes or identities as learners of science at the science camp. I believe another implication of this study is to develop science camp programs that avoid activity structures such as lectures and triadic dialogue. I argue that the content could be presented to participants in ways other than lecture. For example, designers of science camp programs could encourage science talks or student questioning to convey science content in ways that differ from lecture. I further believe that the use of triadic dialogue at the science camp encourages rote memorization of facts in ways that are parallel to the school science classroom. An additional implication would be to at times use open-ended questions in the science camp rather than exclusively relying on recall questions.

A third implication of this study would be to provide adults with a background for interacting with science camp participants. There were times when adults dominated the conversations and controlled learning activities. When adults dominated the conversations, participants had fewer opportunities to contribute and their identities as learners of science did not seem to be positively influence by such conversations. This was particularly noticeable on the research cruise when Mr. Crawford and Mrs. Roberts took control of the data collection activities. I speculate that the parent chaperones likely did not have a background in education and drew on their experiences as learners in traditional classroom settings to consider how they would interact with participants. Science camp program designers could provide a brief introduction session with suggestions for ways of engaging with participants. In this way, parent chaperones would learn ways to appropriately engage with science camp participants.

The findings from this study suggested several implications for science camp programs. I believe that my study advocates areas of consideration for the development of science camp programs. First, science camp developers should design learning activities to optimize opportunities for learners to engage in group conversations. Second, science camps should shift away from lectures and triadic dialogue and instead promote science talks, learner questioning, and open-ended questions. Finally, science camp field trip programs should provide for adults appropriate ways to engage with science camp participants.

Areas for Future Research

Although for the purposes of this study I end my discussion of my insights in this report, I believe there are areas for future research that might build on the insights gained from this research. Questions for future research include: (1) How do other science camp cases support or extend the research findings from this study? (2) How are aspects of participants' identities as learners of science supported, reinforced, or abandoned as they return to the school science setting and the conflict between the norms in each of these science learning settings? (3) What are the long-term, longitudinal influences of the science camp program on participants' identities as learners of science? (4) How are teachers' views of science teaching and learning influenced by participation with students at the science camp field trip program? (5) How are the identities as learners of science influenced by a science camp program for participants from groups that have been traditionally underrepresented in the field of science?

This study represented a preliminary effort for understanding how participants' identities as learners of science developed at one science camp program. This exploratory case study provided an in-depth account of one science camp case. Future research would investigate additional science camp programs to build on the findings that emerged from this study of one program.

The unique features of the science camp setting afforded resources for identity development as learners of science. Participants reported that there were specific aspects of the science camp program that influenced identity development as learners of science. Future research would explore how these newly shaped aspects of participants' identities were supported or abandoned as participants returned to the science classroom. An ethnographic study of students before and after the science camp program in their school settings would provide a deeper understanding of how the science camp program influenced participants' identities as learners of science.

This study suggested that there were immediate influences of a science camp program on participants' identities as learners of science. However, I did not collect evidence regarding the long-term influences of the science camp program on participants' identities as learners of science. A future area of study would be to follow-up with participants to elucidate the long-term impacts of a science camp program on participants' identities as learners of science. The findings also suggested that participants were considering science as a career option. A long-term qualitative study could investigate whether participants maintained this interest in a science career.

Anecdotally, the teachers that attended the informal science education field trip with their students mentioned to me that the program may have influenced their views of science teaching and learning. For example, two of the teachers mentioned that they were going to provide students with more opportunities to engage in conversations when they returned to the science classroom setting. These comments by the teachers prompted me to question how the science camp program influenced their own identities as science teachers. A future study might investigate the ways that teachers' views of science teaching and learning were influenced by participation in an informal science education camp setting.

Although I made an effort to represent diversity in this study, the participants that attended the science camp program during the study period were predominantly white students from middle class backgrounds. A future area of research would be to examine a more diverse sample to gain a broader range of perspectives on how identity as learners of science develops through learning conversations at an informal science education camp.

A limitation of this study was that because learning conversations are intricately linked with the informal science education setting, it was difficult to tease out whether the conversation or the setting was the main influence on participants' identities as learners of science. A future study could use an experimental design to consider the primary factor influencing participants' identities as learners of science. Using an experimental design, I could create a control situation in which learners participate in lectures in the context and are prompted to refrain from interacting with others during the science camp activities. In establishing a comparison group, I could speculate as to whether the setting or the conversations influenced participants' identities as learners of science. Ethically, however, I do not feel that I could engage in such a study that contrasts with my views of learning in informal science education settings. I believe that the opportunity to socially interact with others is a fundamental characteristic of informal science education settings. I believe that asking participants not to socially interact with one another would take away from the experience of engaging at an informal science education setting.

Chapter Summary

In this chapter, I summarized the main findings of my study and drew conclusions about how learning conversations at an informal science education camp influenced participants' identities as learners of science. I addressed sub-topics such as group identity and suggested ways that members of the community of science learners developed in ways such as learning more about one another, taking on new roles and negotiating power. I discussed the ways that insights from my research study build on previous science education research. Specifically, I believe my study addressed gaps in the literature specifically in the areas of discursive identity, group identity, learning conversations between peers in a new context, and learning in science camp settings. I suggested that the findings of this study have implications for science education, particularly with regard to the design of informal science education camps. Finally, I recommended areas for future research.

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Appendix A: Focus Group Interview Protocol

Central Research Question: How do middle school students construct identities as learners of science during shared learning conversations at a science camp field trip?

1. Your friend asks you, "what is science?" What would be your response?
2. What do you hope to learn about science at this camp?
3. How do you use science in your everyday life? Expand/Elaborate.
4. Do you think you need science? Why or why not?
5. How do you see yourself as a science learner? Elaborate.
6. How do you think others see you as a science learner? Elaborate.
7. Do you think you will pursue a career in science? Why or why not?
8. (post-camp): Please share any further thoughts on your science camp experience and how it may have influenced how you think and feel about science.
9. In thinking back over the experience, what are some of the activities that influenced how you think and feel about science?
10. How has the science camp experience changed how you see yourself as a learner of science?
11. During your science camp experience, did you talk about science during the activities? Explain.
12. How did your friends help you to learn science?
13. Do you have anything more you would like to add about the science camp experience?
14. Would you recommend the science camp program to a friend? Why or why not?

Appendix B: Teacher Interview Protocol

1. How does (student) participate usually in science lessons?
2. How do you see (student) as a learner of science?
3. How do you think (student) sees himself/herself as a science learner?
4. Do you think he/she has confidence in his/her abilities as a science learner?
5. (post-camp): How do you think (student) has changed as a result of the informal science camp?
6. (post-camp): How is (student) different in the science camp setting than in the classroom setting?

Appendix C: Journal Reflection Prompts

Day 1: Tell me about your prior experiences learning science. How do you see yourself as a learner of science? Do you think science is your strength? Do you learn science easily? Are you confident in your ability to learn and do science? Please feel free to write your response or include drawings.

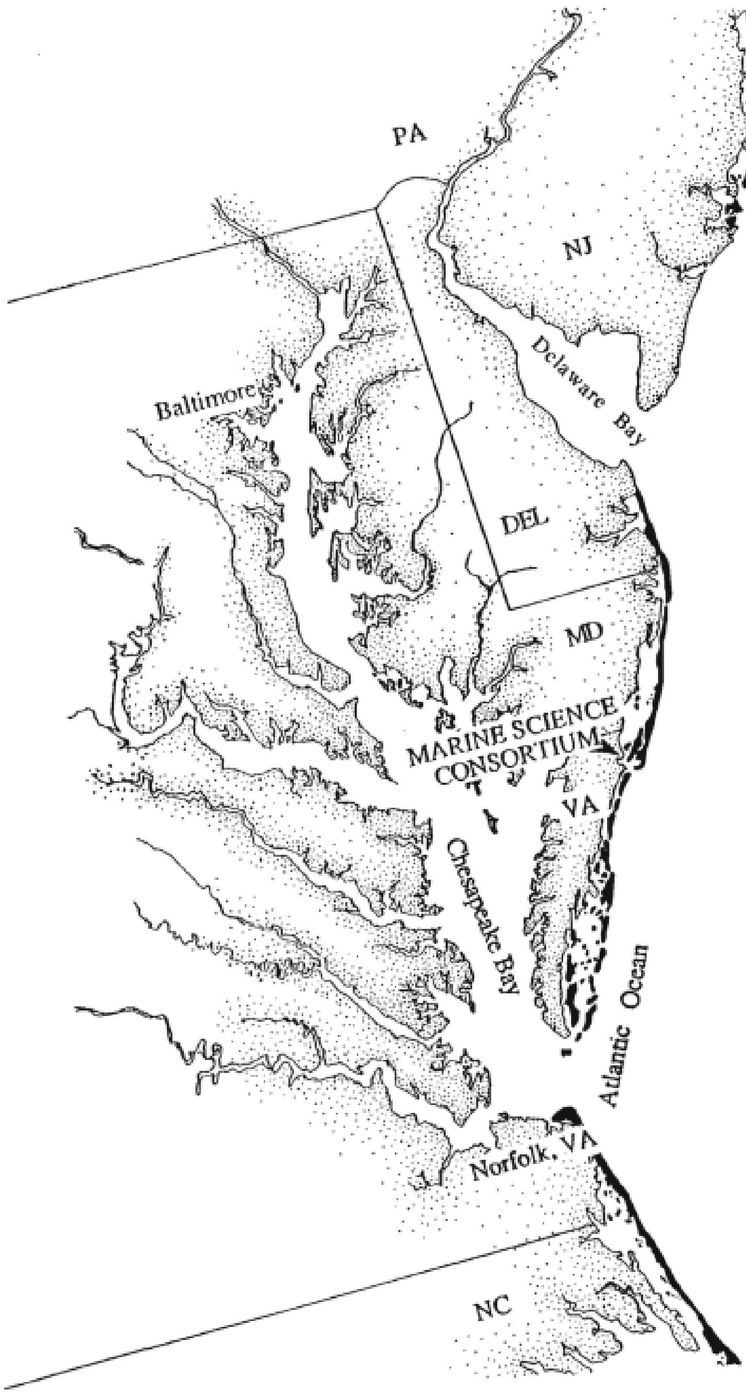
Day 2: Reflect on today's activities. How have today's science activities influenced how you see yourself as a learner of science?   Are you different in the science camp setting than you are in the classroom? Did your conversations with your classmates, teacher, and staff today impact how you think about yourself in science? Please feel free to write your response or include drawings.

Day 3: Reflect on today's activities. How have today's science activities influenced how you see yourself as a learner of science?   Are you different in the science camp setting than you are in the classroom? Did your conversations with your classmates, teacher, and staff today impact how you think about yourself in science? Please feel free to write your response or include drawings.

Day 4: Think about the science camp experience. Describe how the science camp influenced your ideas and feelings about learning and doing science. Please feel free to write your response or include drawings.

Appendix D: Maps of Study Location

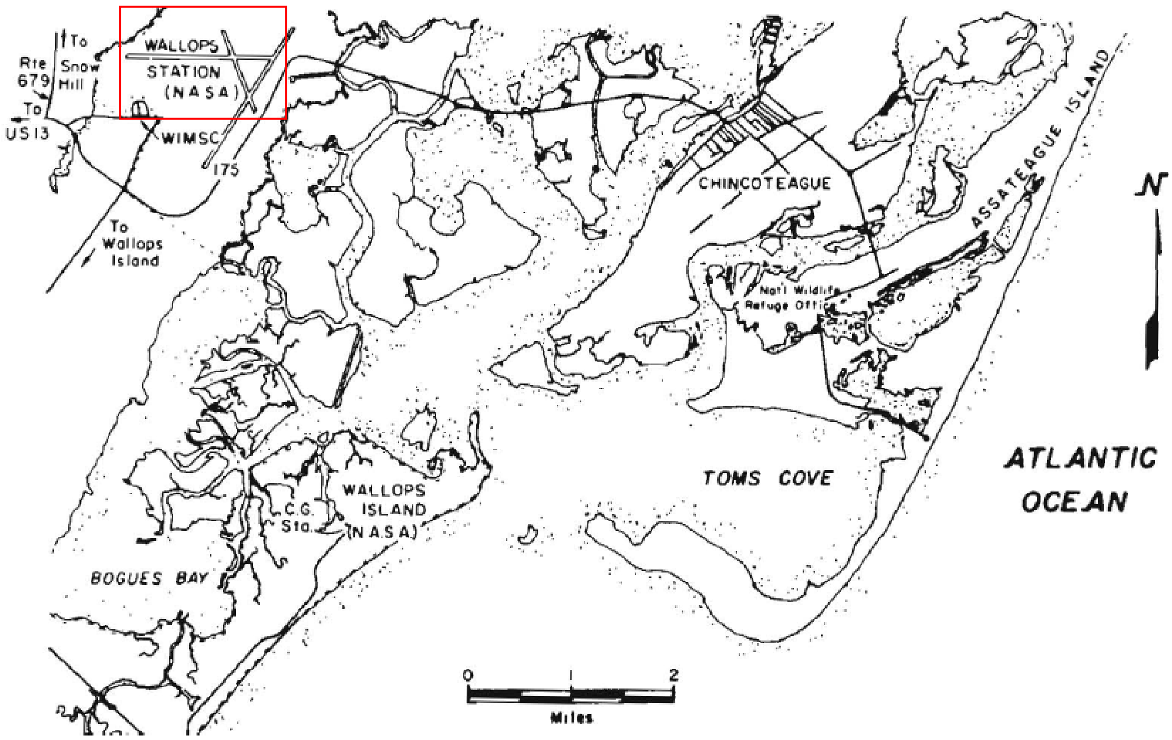
Figure 5. Map of the Eastern Shore.



(Image courtesy of the Marine Science Consortium, 1995)

The Marine Science Consortium is located on the Eastern Shore in Virginia, approximately four miles south of the Virginia-Maryland state line. The field station itself is located in Wallops Island, Virginia. This map highlights the consortium's geographic location in relation to the entire Eastern Shore and the states of Maryland and Virginia.

Figure 6. Map of Wallops Island, Chincoteague Island and Assateague Island.



(Map image courtesy of the Marine Science Consortium, 1995)

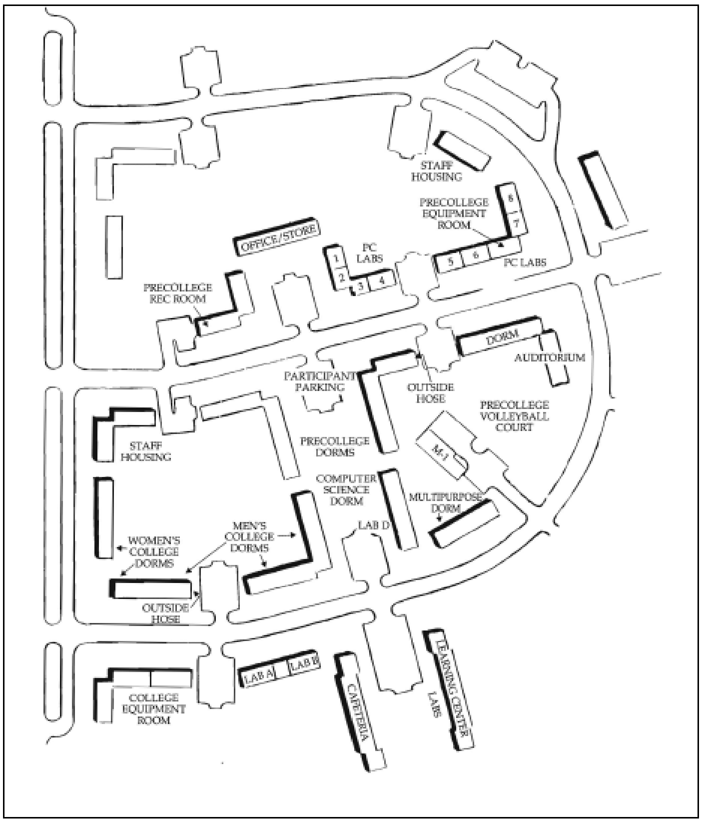
This map provides a closer view of the study location and the surrounding areas in which the science activities took place. The Marine Science Consortium, located in Wallops Station, is outlined with a red box. The field-based experiences took place in the surrounding ecosystems including, but not limited to: Wallops Island, Chincoteague Island, Tom's Cove and Assateague Island.

Appendix E: A Day in the Life of Camp

As a means to provide a detailed description of the science camp context, I will portray the experiences of a participant in the *Coastal Ecology* field trip at the MSC field station on Wallops Island. Throughout the description, I will use a hypothetical participant which I refer to as "the camper." I outline the typical experiences of the camper as she engages in the activities of the program.

The camper arrives by bus at the MSC Wallops Island field station with the teachers, chaperones and fellow students from her school. As the bus pulls in to the field station, the camper looks out the window of the bus and views the dormitories, classroom laboratories and offices that line the field station (Figure 7). An MSC educator climbs on board the bus and introduces herself to the school group. The bus then travels on the road that extends around the perimeter of the field station and delivers students to the newly constructed student dormitories. Chaos ensues as the camper and her fellow peers disembark from the bus, collect their luggage, find roommates and an available dorm room. The camper finds her dorm room and unpacks alongside her roommates.

Figure 7. Map of the facilities at the MSC Wallop's Island field station.



(Map image courtesy of the Marine Science Consortium, 1995)

Immediately following unpacking, the camper leaves the dorms with her school group and find the laboratories where the school group will complete some of the science activities throughout the four day program (Figure 8). As she enters the classroom laboratory, her senses are engaged by the smell of the salt water and of the organisms maintained in the aquaria and pools around the classroom. The noise of the pumps that support the aquaria echo throughout the room. Lining the walls of the classroom are numerous colorful posters and information pamphlets describing organisms and ocean phenomena. In the center of the classroom are two long lab tables where the camper sits alongside her fellow camp participants. Adjacent to the lab tables are shelves and cabinets containing equipment such as microscopes, field guides, and nets that will be used throughout the camp program during science activities.

Figure 8. Photographs of the laboratory classrooms at the Marine Science Consortium.

As the camper and her fellow participants are settled in the laboratory, an MSC educator introduces herself, orients the group to the facilities and describes the rules the campers must adhere to while on the MSC campus. She provides the campers with their four day schedule for the program and describes the activities with which they will engage (Table 9).

Table 9

Sample science camp schedule

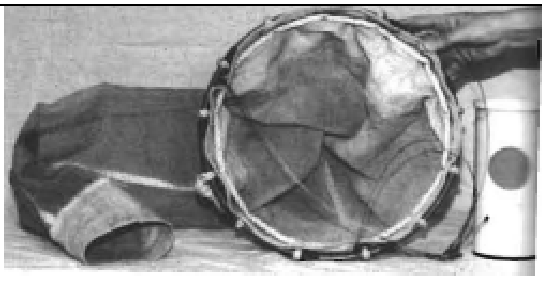
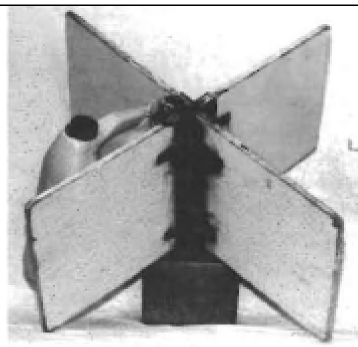
	Day 1	**Day 2**	**Day 3**	**Day 4**
Morning		Breakfast 8-8:30am Research Cruise 9-11:30am	Breakfast 8-8:30am 9-11am Marsh Field Experience	Breakfast 8-8:30am 9:00-11am Maritime Forest at Lighthouse Trail on Assateague Island
Afternoon	Arrive at MSC Check-in	Lunch 12:30-1pm 1:30-4:30 pm Intertidal Field Experience at	Lunch 12:30-1pm 1:30-4:30pm Dunes Field Experience at	Check-out Depart MSC

		Tom's Cove	Wallops Island	
Evening	Dinner 5:15-5:45pm 6-8pm Equipment Lecture Quiet hours 11pm-7am	Dinner 5:15-5:45pm 6:30-8 pm Organism Lab Quiet hours 11pm-7am	Dinner 5:15-5:45pm Free Night Rec. Activity 7-10pm bowling Quiet hours 11pm-7am	

After the orientation session with the MSC educator, the campers are allowed free time until dinner. The camper socializes with her friends in the dorms and engages in physical activities such as playing volleyball on the campus court or kickball in the open green areas outside the dorms. Eventually, dinner time arrives and the camper joins her classmates, teachers, chaperones and MSC staff at the dining room located in the center of the field station.

Following dinner, the camper goes to her first science activity of the camp, the equipment lecture. At the equipment lecture, the camper learns about the equipment that will be used on the research cruise the following morning and the methods used to collect oceanographic data. The camper is introduced to equipment such as the Van Dorn bottles for water collection, a refractometer to measure salinity and a current cross for physical oceanography observations (Figure 9).

Figure 9. Oceanographic equipment discussed during the equipment lecture and used for data collection on the research cruise (Equipment images courtesy of the Marine Science Consortium, 1995).

 Plankton Net	 Current Cross
 Refractometer	 Van Dorn Bottles

The camper records notes on the equipment as well as lists the procedures for completing the activities for the cruise the next morning. Before the lecture concludes, the camper is able to see and handle the sample equipment that is set up around the classroom. This familiarizes the camper to the equipment before the research cruise.

That evening, the camper has more free time to socialize with friends, play card games and watch movies in the dormitory lounges. At eleven o'clock, the camper is informed that quiet hours will begin and extend until the following morning. The camper goes to bed along with her three fellow roommates and anticipates the activities of the camp that will take place the following morning.

The next morning, the camper commences her first full day of the science camp program. She begins the day with breakfast in the dining room and then prepares for the research cruise. The camper and her school group meet and begin in the laboratory classrooms. In the laboratory, the MSC educator provides a brief orientation to the cruise. The camper listens to a review of the safety information and activities they will complete on the research cruise. A bus pulls up out front of the building and the campers leave the laboratory, load the equipment, and then pile onto the bus. They leave the field station and take a short ride to the boat docks located on the NASA Wallops Flight Facility. As they pull into the gate of the facility, the camper gets a view of the two research vessels, the R/V Flatfish and the R/V Mollusk, and the boat captains (Figure 10). The campers leave the bus and unload the equipment.

Figure 10. An MSC research vessel used for the camp program.

The camper walks down the boat docks and steps onboard the research vessel where she is instructed by the boat captain to obtain a life jacket. After all of the campers are onboard, the captain re-iterates the safety procedures and boat rules. As the boat pulls away from the docks, the camper signs a boat log and is seated along the dock boxes. The boat travels through the marsh, passing by numerous organisms such as egrets, herons and oyster reefs. The boat arrives on station and the camper watches as the boat captain and MSC educator anchor the boat.

Once the boat is anchored, the camper stands and finds her group. She then begins collecting oceanographic data at one of four activity stations set-up around the boat. The stations include a physical observation station, a navigation station, a water collection station and a water quality station. At each activity station, she engages and converses with her group members to make sense of the information in her field guide and appropriately complete the data collection procedures. She discusses with her group any calculations necessary to convert data into the correct units. She may debate with her group members as to how to collect or interpret the data. At times, she and her group may ask a chaperone, teacher or MSC educator for help.

Following the data collection activities, the educator describes procedures for collecting biological organisms. She shows the campers how a benthic grab is used to collect worms and other organisms that live in the marsh mud. She holds up a plankton tow net and describes how the net is towed behind the boat to collect planktonic organisms. Finally, she discusses the otter trawl and the procedures for deploying and retrieving the net from the boat and asks for volunteers to help with the procedures. With the help of the captain, the educator and campers release the net which is then towed for 10-15 minutes behind the boat. The captain guides the boat slowly through the marsh stream as the net captures organisms. The net is then brought back on board. It is laid out across the boat deck as the MSC educator quickly and frantically searches through the net for organisms such as fish, jellyfish and other organisms that must be quickly returned to water or that could be hazardous to campers. The camper joins the educator, taking organisms from the net and quickly placing them in holding wells and buckets on the boat.

The organism collection concludes and the camper returns to her seat on the dock box. She looks over the rail of the boat and watches the marsh and organisms as the boat travels back to the boat docks. At the docks, the camper helps the educator load equipment and buckets of organisms back on to the buses. The campers pile back on to the bus and make the short trip to return to the MSC field station.

Upon returning to the field station, the camper has free time to shower and clean-up from the research cruise. She then joins her school group and MSC staff in the cafeteria for lunch. After lunch, she gets ready for the intertidal field experience that the group will take at Tom's Cove. She packs her clean change of clothes for after the trip and then walks with her fellow campers back to the laboratory.

In the laboratory, the camper listens to a brief, 15-20 minute lecture from the MSC educator about the intertidal community. She records notes on the different zones of the intertidal ecosystem, the characteristics of the community, the dominant vegetation, and organisms found in this ecosystem. The MSC educator tells them about the seine nets and sieve boxes that they will use to collect organisms during this field experience.

Again, the camper and her peers load into the bus and ride to Tom's Cove. The ride is a little longer than this morning as they cross over the causeway onto Chincoteague Island. Along the ride, the MSC educator provides stories and background information about the island and its inhabitants. They reach the Chincoteague National Wildlife Refuge and Assateague National Park. Through the gates, the bus continues along the road, passing by marshes as well as organisms including the ponies of Chincoteague Island. The bus pulls off along the side of the road at a trail head. The group offloads from the bus and hikes along the trail with their equipment. Walking along the trail, the MSC educator stops the group periodically and points out animals, identifies vegetation and tells stories about Tom's Cove and local lore. The trail eventually opens up to Tom's Cove, an intertidal area situated between Wallops Island, Chincoteague Island and Assateague Island.

Arriving at Tom's Cove, the MSC educator tells the group to do a quiet sit and observe nature using their senses. The camper walks around the intertidal zone of

Tom's Cove and sees such things as the shore birds flying over head, the periwinkle snails attached to the marsh grass and blue crabs swimming through the stream. She hears the sound of the shore birds, the water lapping on shore as the tide moves in, and the breeze blowing through the *Spartina* cord grass. She smells the decaying organic matter which gives the mud a distinct sulfur smell. She feels the wind blowing and the cool water as she wades in the cove. After about five minutes, the camper joins the rest of her group with the MSC educator and shares her observations. She listens to the observations shared by her peers as well as the educator who adds scientific background information to the group discussion.

The group then listens to a brief lecture as the MSC educator leads the group to each of the intertidal zones and re-iterates the characteristics, dominant vegetation and organisms of each zone. The MSC educator asks the camper a question, asking her to recall a piece of information that was taught during the lecture in the laboratory. The camper responds and the educator evaluates her answer. The MSC educator continues through each of the zones, asking the campers questions and adding scientific information as she deems necessary. In each of the zones, the MSC educator uses a quadrant. The camper and her peers observe the section of the zone distinguished by the quadrant, noting the organisms that appear to dominate this zone.

After visiting and discussing each of the zones, the camper finds her small group, collects a sieve box, shovel and a jar for collected organisms. The camper and her group wade out into the waters of Tom's Cove. They stop at a point and divide up the tasks. One of the group members will use the shovel, another keeps the jar for organisms, and several campers hold the sieve box. The group collects a shovel of mud and sifts through it for organisms using the sieve box. They find several snails and a worm which they place in the collection jar. They continue this for about 20-30 minutes after which they hear the educator call them back to shore.

The next activity on the intertidal trip is seining. The MSC educator first discusses the seine net and demonstrates how to use the net to collect an optimal number of organisms. The camper takes one side of the net as another of her peers holds the other side. They enter the marsh stream with the net. The rest of the group gathers about 100 yards away. The MSC educator yells “Go” after which the group rushes toward the nets that the camper and her partner are holding. After they meet, the camper and her partner lift the net and the group examines their catch. In the net, they observe such organisms as fish, crabs, and jellyfish. They decide to keep some of the organisms and place them in buckets of water to return to the aquaria in the laboratory. They repeat seining several more times before concluding the intertidal field experience. All of the equipment is gathered and they walk back on the trail, load the bus and drive back to the MSC field station.

Returning to the field station, the camper and her group again have free time and dinner before reconvening in the classroom laboratory for an evening lab. The evening’s lab includes a macro- and micro-organism lab as well as a review of the cruise data and a visit to Mo, the Green Moray eel housed in the aqua lab on campus. All of the groups are asked to record their cruise data on the front board. The camper represents her group and writes on the board the data they collected on the cruise such as the water temperature, the salinity of the water, the direction and speed of the current, and the water clarity. The MSC educator then uses some of this data to show the students how to create a depth profile. In oceanography, depth profiles illustrate how aspects such as temperature, salinity, density and pressure change with depth.

The educator also discusses how to interpret and make sense of the rest of the data from the cruise.

Following the discussion of the cruise data, the camper listens to a lecture on classification. She learns from the MSC educator about biological classification of organisms and scientific names. The educator also discusses how to identify the organisms using field guides and dichotomous keys. After the lecture, the camper finds a group and sets to work on identifying some of the organisms around the classroom. In total, there are approximately 20-25 organisms around the laboratory that the group is responsible for identifying.

In her group, the camper examines the characteristics of their first organism. The organism is labeled with the phylum to which it belongs. This helps the camper locate the appropriate organism descriptions in the field guide. The organism is labeled as belonging to the Phylum Arthropoda. The camper looks in the field guide for Arthropods and finds the page for the descriptions. She reads through the first organism description and compares this to the features of the organism in question. She discusses the characteristics with her group members, citing evidence as to why she believes it is not the correct identification for the organism. The group discusses and confirms that the identification is not appropriate. The camper moves on to the next description and repeats the process until the correct organism is determined. Based on the characteristics and the descriptions in the field guide, the group believes the organism is a blue crab, *Callinectes sapidus.* They call for the MSC educator who comes to the camper's group and confirms their guess. The camper and her group members record the common name and scientific name in their field books and then move on to the next organism.

After all of the organisms have collectively been identified by the groups, the MSC educator goes through and gives the correct name for each of the organisms as well as any background information she finds relevant. The group then leaves the classroom laboratory and walks across the campus to the aqua lab where Mo, the green moray eel, is housed. They walk in to the aqua lab and find Mo swimming around in his tank. The MSC educator prepares some food for Mo and then feeds him while the campers observe. She answers the campers' questions about Mo as she feeds him. The group observes excitedly for a while and then returns to the classroom.

The final activity of the evening is a micro-organism lab which begins with a lecture about plankton. Following the lecture, the camper selects a partner and together they find a microscope. The camper prepares a slide using the water collected from the plankton tow on the research cruise. She places the slide under the microscope and works with her partner to find a planktonic species in their sample. They use trial and error to locate a plankton, moving the slide around and focusing the lens. Eventually, they locate a plankton and observe it through the viewfinder of the microscope. They discuss the plankton and compare it to the various sketches in the plankton field guide provided for them in the laboratory. They draw the plankton species in their field guides. After identifying and drawing three different plankton species, they conclude the microorganism lab and return to their dorms for the evening.

The next day follows similar to the previous day. The camper joins her school group for breakfast and lunch in the cafeteria. Throughout the day, she participates in field experiences to the marsh and to Wallops Island. She has free time between activities and meals during which she socializes, engages in physical activities and plays games with her peers. However, this evening is different from the previous and instead of participating in a science lab, the school group has a free night for a recreation activity. The teacher of the camper's school group organized a night of bowling. A bus departs the MSC field station and takes the campers to the bowling alley where the camper spends the evening eating pizza, bowling, and playing arcade games.

The following morning marks the final day of the camp program. As with every morning at the camp program, the camper begins her day with breakfast in the cafeteria following by a field experience to the maritime forest. Today, the group leaves for Assateague Island and the lighthouse walk through the maritime forest ecosystem. The school group boards the bus and makes the trip again to the Chincoteague National Wildlife Refuge on Assateague Island. When they arrive, they begin along the trail leading to the Assateague lighthouse. The MSC educator lectures about the maritime forest and stops the group along the hike to point out features of the maritime forest, identify the various trees and other vegetation along the trail, and provide facts about the island and lighthouse. She tells stories she believes will be of interest to the students. For example, the MSC educator shows the campers a Sassafras tree and describes how the root of this tree was previously used to make root beer.

Once the group reaches the lighthouse, the MSC educator holds a ceremony during which each participant is recognized for their participation and receives a certificate of completion. As they are called in front of the group to accept their certificates, they are asked to state something that they have learned during the program and an activity that they enjoyed at the camp. After the MSC educator distributes all of the certifications, the group walks back along the trail, boards the bus and returns to the MSC field station. They have completed the program and will return home to their schools.

Appendix F: Description of Science Camp Activities

Research Cruise

The MSC was equipped with several research vessels, two of which were used for the pre-college science camp programs: the R/V Mollusk and the R/V Flatfish. The research cruises provided students with an opportunity to use oceanographic equipment and instruments for water sampling and organism collection. The research vessels travel through the tidal creeks surrounding the MSC, stopping at stations periodically for data collection. The students were asked to record all of their data in individual field notebooks. During the research cruise, camp participants engaged in a number of science activities, each described in detail below.

Water Quality Testing. At one of the cruise stops, the camp participants were expected to collect and test a water sample for the following data related to water quality: salinity, temperature, pH, and dissolved oxygen.

The sample of water was collected on the research cruises using Van Dorn bottles which can be used to sample water at any depth. The bottles were lowered into the water in the open position. After the desired depth was reached, a messenger weight was dropped down a cable causing the bottle to turn over. The reversing action resulted in the bottle closing to collect the sample which was then brought back aboard the boat (field notes, May 2010; MSC, 1995).

A refractometer was used as a means to test the salinity of the water sample. The refractometer measures the bending of light waves as they pass from air into the salt water solution. The amount of bending is used to determine the concentration of salt in the water sample. To use the refractometer, the students placed a drop of the water on the lens and viewed a scale to read the salinity of the sample (field notes, May 2010; MSC, 1995).

Temperature was collected using a standard thermometer. The participants were instructed to record temperature data in scientific units of Celsius. Therefore, students would read the temperature from the thermometer in degrees Fahrenheit and were expected to convert to degrees Celsius before recording the data in their field notebooks (field notes, May 2010).

The pH was determined using a test kit that measures the concentration of hydrogen ions in the water solution. Students would place a sample of the water in the test kit and add an indicator solution that altered the color of the sample. The resulting color was then compared to a set of color standards to approximate the pH of the water (field notes, May 2010; MSC, 1995).

Students used the Winkler titration method to measure the dissolved oxygen of their water samples. The water sample was chemically prepared and then students added a titration solution until an endpoint color change took place. The amount of titration reagent added to the solution is proportional to the amount of dissolved oxygen in the solution, allowing for students to measure the level of dissolved oxygen in the water (field notes, May 2010; MSC, 1995).

Navigation. At the navigation station, the boat captains taught the students nautical navigation using the triangulation method. The boat captain showed the camp participants how to use a navigation chart, compass and parallel ruler to determine the latitude and longitude of the boat’s position (field notes, May 2010).

Physical Observations. The physical data collected on the research cruise included: water turbidity, water color, tidal current speed, and tidal current direction.

Students used a secchi disc to measure the turbidity of the water. The disk was lowered into the water column until no longer visible to the student observers. The depth of the disk was then recorded. The depth of visibility is related to level of turbidity of the water (field notes, May 2010; MSC, 1995).

The Forel Ule color scale was used to measure the color of the water. Students matched collected water samples with standardized color scales. The color of the water indicated the biological productivity and amount of sediment in the water (field notes, May 2010; MSC, 1995).

A current cross, compass, and stopwatch were used to determine the current speed and direction. The current cross is made of wood connected to create a cross that is attached by a length of rope. Students placed the current cross in the water and timed how long it took for the length of rope to become tight. Using the equation for velocity (distance/time), the students calculated the current speed. The compass was used to determine the direction of the current cross and resulting current direction (field notes, May 2010; MSC, 1995).

Sediment Sampling. The benthic grab was used to collect bottom sediment samples during the research cruises. The grab is sent down to the bottom in the open position and the pressure of hitting the bottom releases a trip arm that closes the grab to collect a sediment sample. The grab is then brought onboard the vessel and the arms open to retrieve the sample. Students analyzed the sample for color, grain size, odor and presence of organisms (MSC, 1995).

Biological Sampling. Two methods of biological sampling were used during the research cruise: a plankton net and otter trawl. Both the plankton net and otter trawl were towed through the water for a period of time.

The plankton net is made of mesh small enough to collect planktonic organisms while allowing water to pass through. A bottle was attached at the mouth of the net to collect a sample of water. That sample was later used in the lab to create slides for viewing plankton under the microscope (field notes, May 2010; MSC, 1995).

The otter trawl was a net that trapped larger macro-organisms while being towed through the water. After trawling for a period of time, the net was brought on board and the animals trapped in the net were either returned to the water or placed in holding tanks onboard the vessel. The organisms collected were later maintained in aquaria at the MSC and used for the organism lab (field notes, May 2010; MSC, 1995).

Organism Lab

The organism lab typically took place on the second evening of the trip, after the school groups collected sufficient organisms on the research cruise and one of the field-based trips. Primarily, the purpose of the organism lab was to introduce the camp participants to the techniques of identifying organisms, as well as provide background information about classification and the taxonomy. The lab was split into three components: a macroorganism lab, a review of research cruise data and a plankton lab. Below, I explain each of these components in more detail.

Macro-organism Lab. Each of the macro-organism labs observed began with a lecture on taxonomy, organism classification and scientific names. This taxonomy lecture typically lasted between 15-30 minutes and concluded with instructions for using the field books to identify the organisms for the lab. The lab was set-up with a variety of organisms, most of which were collected during the research cruise and field-based experiences. Organisms included in the lab ranged from single-celled organisms and algae up through more complex organisms such as vertebrate fish.

Following the lecture, the camp participants split into small groups of between three to five students and assigned themselves to one of the organisms scattered through the classroom. The instructors labeled each of the organisms with the appropriate phyla before beginning the lab with the students. For most of the organisms, students were instructed to read the scientific information about the phylum of the organisms and then compare the descriptions in the field book to their observation of the organism to determine the correct identification. The fish were identified using dichotomous keys in which students followed a flow-chart of characteristics to determine the correct classification of the fish. Once the groups believed they had a correct identification, they were then instructed to check their guesses with the instructors and record the name of the organism on the board once verified. The identification of all organisms lasted from one to two hours. The groups were then brought back together as a class and instructors would then provide the correct identification and some brief background information for each organism.

Research Cruise Data. A portion of the organism lab was devoted to reviewing the students' data from the research cruise. The MSC instructors directed the students to record their water quality data on the front board, including the water temperature, pH, salinity, and density data. After each of the groups provided their information, the MSC instructors demonstrated how to create graphs to illustrate this data. They then lectured about depth profiles which demonstrated how each of the water quality measurements changed with depth. This lecture often lasted approximately 15-20 minutes.

Plankton Lab. The plankton lab began with a brief lecture on basic plankton definitions (e.g., plankton, nekton, haloplankton, meroplankton). Camp participants were then instructed to create microscope slides from the water samples collected during the research cruise. In pairs or small groups of three, the students viewed their slides under microscopes in search of planktonic organisms. They then used dichotomous keys and field guides to identify each of the plankton observed on the slides. After verifying their guesses with MSC instructors, the participants were instructed to draw a picture of each plankton and record the identification information in their fieldbooks. The plankton lab was complete after each group identified at least three types of plankton.

Field-Based Experiences

The science camp participants spent much of the program engaged in field-based experiences in the ecosystems surrounding the MSC. Field-experiences included trips to intertidal beaches, salt marshes, dune systems and maritime forests. Each field-experience typically began with a brief introductory lecture that oriented the students to the local ecosystem. Following the lecture, camp participants engaged in data collection and organism collection. They also noted the characteristics that defined each specific ecosystem.

Intertidal Trip. For the intertidal field experience, the MSC instructors and science camp participants traveled to Tom's Cove on Assateague Island. The field-experience often began with a sensory experience in which MSC educators instructed campers to silently sit and use their senses to observe the intertidal location. After the quiet sit and think period, the instructors brought the students back as a whole group to discuss their observations.

Instructors physically led students through each of the different zones of the intertidal ecosystem. As they walked through the intertidal ecosystem, the instructors pointed out the defining characteristics and dominant vegetation for each zone. Often, they would tell stories about organisms living in the zone as a means to attract the students' attention. In each zone, instructors would use a quadrant to count the number of species present. This helped to illustrate, for students, the differences in species diversity from one zone to the next.

After going through each of the intertidal zones, students were then free to explore, in small groups, the sub-littoral zone (the zone that is completely submerged, even during low tide). Using shovels and sieve boxes, the students in each group were able to collect samples of sediment and sift to reveal organisms living in intertidal mudflats. The student groups collected samples in collecting jars. Much conversation was generated during this intertidal activity as students discussed the best methods for collecting organisms and debated the identification of the organisms discovered.

The intertidal field-experience concluded with seining in the tidal creek. The seine net is a large net connected to two poles. Two students hold the poles on each end and extend the net. They then wade through the stream, collecting organisms that get caught in the path of the net. The remaining students line up at the other end of the stream and race toward the seine nets in an attempt to push organisms in to the net. The net is then lifted and any organisms trapped are collected and placed in to buckets or jars for later identification at the MSC lab.

Dunes Trip. The sand dune field trip addresses for students the question: how are sand dunes and barrier islands formed? For the sand dune field trip, the group travels to a nearby NASA/Naval Base on Wallops Island. The beach is private and only visited by MSC groups. A trail leads from the parking lot, through a maritime forest and out to the beach. While walking out along the trail, MSC instructors point out prominent vegetation. The instructors lecture on the process of dune formation and show various dune stages prevalent along the trail and beach to illustrate for students the dune evolution. Once out on the beach, the instructors continue their lecture by discussing coastal geology, specifically longshore transport and barrier island formation. Students are then turned loose to explore the beach and collect shells, skeletons, and other artifacts that have washed ashore. The students had, on average, 30 minutes to collect their artifacts. Some of the students worked individually while others worked in small groups. Following the beach collection activity, MSC instructors called the students back as a whole group to share their artifacts. The instructors sorted through the students' collections, pointing out some of the interesting artifacts and providing relevant scientific information.

Marsh Trip. The MSC campus is surrounded by vast stretches of marsh. For the marsh field trip, the instructors and camp participants visit a marsh situated adjacent to the causeway that connects the mainland with Chincoteague Island. The activities of the marsh field-experience varied week to week. Some MSC instructors primarily engaged participants in a lecture in which they described the common characteristics and dominant organisms in the marsh. Instructors would engage the participants' senses, asking them to note the smell of the marsh, feel the marsh mud between their fingers and taste a dominant marsh plant, saltwort. As an active element of the lecture, the instructors would have the campers jump up and down on the marsh floor to notice vibrations and the spongy feel of the marsh floor. In some cases, participants would split into small groups to investigate the marsh. Campers explored the marsh by noting the salinity, dominant vegetation and diversity of organisms.

Following the marsh learning activities, the instructors led the campers through what they termed the "productivity plunge." The whole group would crowd around a mud hole in the marsh and as a group, would jump into the mud. The campers were given time to play in the mud before exiting and concluding the marsh trip.

Maritime Forest Trip. The camp program often concluded with the Maritime Forest field experience. The maritime forest trip took place at the lighthouse on Assateague Island. The instructors and camp participants hiked along the trail up to the lighthouse for a final certificate ceremony to conclude the program. As the group hiked up the trail, the MSC instructors provided scientific information about how the maritime forest develops as well as interesting facts about the vegetation and organisms in the forest. Once the group reached the lighthouse, they were at a high enough elevation to gain a greater view of the island. From this point, the MSC instructors were able to point out some key geological features of the island as well as review the geological process of barrier island formation that created the island. Following the lecture, the instructors led a ceremony in which each camp participant is given a certificate of completion for successfully finishing the program. When they received their certificate, they were asked to list something they learned on the trip as well as their favorite activity on the trip. The ceremony served as an informal assessment of the program for the instructors.

Appendix G: Pilot Study

As a means to gain an initial understanding of the science camp context, I conducted a pilot study during the summer of 2009. This pilot study helped to shape the research questions of the current study as well as the methods of data collection and analysis. In this section, I detail the insights gained from the pilot study.

The purpose of the pilot study was to examine how a science camp experience influenced students' nature of science views and attitudes toward science. I attended the summer science camp program at the Marine Science Consortium (MSC) as a participant observer. I lived on campus and participated in all camp activities with the participants. During the pilot study, I observed all camp activities and maintained copious field notes. I asked all camp participants during the pilot study (n=34) to respond to drawing prompts and the *Views of Nature of Science, form D* (VNOS) survey (Lederman and Khishfe, 2002). The two drawing prompts included: *What is science?* and *How do you feel about science?* The VNOS survey and *What is science?* drawing prompt were intended to gain access to students' ideas about science. The *How do you feel about science?* prompt was intended to gain access to students' attitudes toward science. In addition to the drawings and survey, ten students were selected to participate in interviews. The interview questions addressed students' views of science and attitudes toward science. I collected pre- and post-camp data to examine changes resulting from the program.

From the pilot study, I learned that changes in students' views of science were minimal during the short-term, seven day science camp program. Therefore, it was not a fruitful area for investigation. I did observe that students' identities as science learners developed during the science camp program. These changes did not necessarily surface through participants' responses to the drawing prompts. Instead, identity development as a learner of science was apparent in interviews and as I observed the students in conversation with one another during science camp activities. This has prompted me to consider the role of conversations in influencing science learner identity development. It further influenced my decision to use observations and interviews as a primary method of data collection.

Below, I provide a case example to highlight how a student's identity as a learner of science developed during the science camp program. The case presented is illustrative of the general pattern of outcomes for science camp participants. Overall, students either maintained or had more positive attitudes toward science.

Stella was a female participant who identified as Hispanic and Asian/Pacific Islander. At the time of the camp, Stella was ten years old and was a rising fifth-grader. She arrived on the first day of camp with her friend and seemed excited about the science camp program. The two giggled as they were greeted by MSC staff and talked excitedly with their instructors and counselor about their anticipation of science camp activities.

In her pre-camp interview, Stella indicated that her father was a biologist and her mother a chemistry teacher. From her background, it would seem that Stella might identify as a learner of science. She had two parents that chose science related professions and who might serve as positive science role models for Stella. She further expressed that she loved animals, an aspect which influenced her decision to attend the science camp program. Stella stated that she didn't believe she was good at science and was attending the science camp program to learn more and become a better student in science. When further probed, Stella suggested that she often gave the wrong answers in class and on tests which she believed indicated she was not good at science.

Stella's pre-camp interview provides an initial lens into her identity as a science learner. She has a love for animals and generally likes science which has led her to engage in science and elect to participate in a science camp program. Although she identifies as the type of person that is interested in science and chooses to engage in science, she lacks confidence in her science abilities. She considers that others would view her as not good at science which she believes is evidenced by her performance in class and on science tests.

During her post-camp interview, Stella suggested that she maintained her love of animals. She stated that the science camp experience made her like science even more. Initially, she thought that animals were the only means to engage hands-on in science. Stella stated that the science camp program helped her to see other ways of engaging hands-on with materials in science. She indicated that she believed she learned a great deal about science from the camp experience. As a means to exemplify how much she learned, she recited a number of facts taught to her by MSC staff and her fellow peers. Stella explicitly stated that she felt different about her abilities in science. She commented that whereas before the camp she felt she was not good at science, now she viewed herself as "so-so" in science. She attributed this change to learning information during the science camp program.

Stella's responses to the interview prompts demonstrate her science learner identity development, particularly with regard to her perceived ability in science. I view learners' self-perceptions as one aspect of a learner's identity as a science learner, an aspect that may influence whether a student will persist in science. Stella described that her views changed with regard to her abilities in science. She began the science camp thinking that she was not good at science and concluded at the end of the program that she was “so-so.” Given the short-term nature of the science camp program, such a change is noteworthy.

In linking back to Falk and Dierking (2000) and Falk and Adelman’s (2005) notion of the contextual model of learning, I view that aspects of the physical and sociocultural context may have prompted these changes. I speculate that the lack of assessment in the science camp environment may have influenced Stella’s perceptions of her science abilities. Her previous view of not being good at science was based on her performance in the classroom and on tests. The lack of formal assessment in the science camp context may have contributed to this aspect of Stella’s identity as a science learner. Stella was able to participate in science without risking a poor performance on a test. The sociocultural context may also have prompted such changes. The science camp program favored peer-peer interactions. These interactions with peers may have provided a more comfortable environment for Stella to participate in science.

Although not an explicit focus of the pilot study, there was evidence to suggest that students engaged in identity development as a learner of science during the science camp program. The survey instruments and drawings as data collection tools did not prove useful in highlighting aspects of students’ identities as learners of science. The interviews and observations did provide preliminary insights into science learner identity development.

Appendix H: IRB Proposal

1. Abstract:

The purpose of this study is to gain insight into the ways in which middle school students construct identities as learners of science during a field trip at a science camp program. A current line of research in museum settings has investigated the ways in which families make meaning from scientific information presented through exhibits. Such research draws on sociocultural theories of learning and focuses on the group as a unit of analysis. Recommendations for future research call for extensions of family learning conversations to settings beyond museums as well as investigating the ways in which peer groups engage in learning conversations (Astor-Jack, Whaley, Dierking, Perry, & Garibay, 2007; Bell, Lewenstein, Shouse, and Federer, 2009). Bell et al. (2009) speculated that individual and group identity might be shaped and reinforced during museum learning conversations. The research I propose seeks to gain insight into the ways that peer groups engage in learning conversations at a science camp setting and how students' identities as learners of science are constructed or reinforced during these conversations.

The study will examine the experiences of 300 students, ages 9-14, as they engage in a four day field trip experience at the Marine Science Consortium's science camp program. The study will include all students attending the Marine Science Consortium on a field trip with their schools that agree to participate in the study. To investigate students' developing identities through learning conversations, student participants will be asked to engage in interviews, maintain a journal and be observed during science camp activities. A bulk of the data will include videotaped observations of students as they engage in peer groups and with instructors, parent chaperones and their teachers during science instruction. I will also interview the students' classroom teachers for their perspectives.

Participation will be voluntary and participants and parents of participants will sign a consent form if they agree to participate. Students under the age of 18 will sign an assent form. The consent and assent forms will explain the research project and the voluntary nature of their possible participation in the interviews, observations, and collection of artifacts. Participants and parents of participants will be informed that they may withdraw from the study at any time without penalty.

2. Subject Selection:

The subjects will include students ages 9-14 that attend the Marine Ecology field trip program at the Marine Science Consortium in Wallops Island, Virginia. Students are already registered through their schools for the program and will be invited to participate by a letter of invitation distributed by their classroom teachers. All students who agree to participate, up to 300 students, will be the subjects for the observations and journal activity. From this pool of participants, a smaller subset of 20 participants will be randomly selected as case studies for interviews and in-depth observations during science activities and instruction. The subjects for the study will not be selected for any specific demographic characteristics. The classroom teachers will be interviewed for their perspectives on students' identities as science learners. As observing students during instruction and engagement in activities will subsequently involve indirect observation of staff members, teachers, and parents (a maximum of 50) leading the instruction and activities, consent from staff members, teachers, and parents will also be obtained. All potential participants will be encouraged to ask the researcher questions throughout the duration of the study and will be informed that they may withdraw from the study at any time without penalty.

3. Procedures:

Student participants (N=300) in the study will be observed during science camp activities and asked to keep a journal during the science camp program. Some students (n=20) will be selected as case studies for in-depth observations and to participate in group interviews regarding their identity as a learner of science. Observations will be videotaped and transcribed for analysis. Observations will be analyzed using methods of discourse analysis. Security permission will be obtained from participants to videotape prior to beginning the study. All participants will be encouraged to ask the researcher questions throughout the duration of the study and will be informed that they may withdraw from the study at any time without penalty.

The journal will be used to gain insight into students' identities as learners of science. On the first day of the program, the student participants will be asked to record a journal entry by writing about themselves and their prior experiences learning science. At the end of each day during camp, students will be asked to write about their experiences in science activities and instruction. Participants will be given as much time as needed, but it is expected that each entry will take approximately 10 minutes to complete each day (total of 40 minutes maximum per student throughout the 4 day program). Students' responses in journals will be analyzed using qualitative methods to code for emergent themes.

Focus group interviews with a subset of participants (n=20) will be conducted. Participants will be asked to discuss, in a group format, their experiences with learning science. It is anticipated that the survey will last approximately 15 minutes. Students will participate in pre-camp and post-camp interviews for a total time of 30 minutes. The interviews will be videotaped and later transcribed for analysis using qualitative methods to code for emergent themes. Security permission will be obtained from participants to videotape prior to beginning the study.

Classroom teachers agreeing to participate will be interviewed for their perspectives on their students as learners of science. The interviews will take approximately 15 minutes and will occur at the beginning of camp and on the last day of camp (for a total of 30 minutes per classroom teacher). The interviews will be audiotaped and later transcribed for analysis using qualitative methods to code for emergent themes. Security permission will be obtained from participants to audiotape prior to beginning the study.

A member-check is a procedures that allows participants to review, edit, add, and/or subtract information in research transcripts. This procedure will be performed to increase the validity of the data and reduce any anxiety participants may have about the accuracy of their responses and the researcher's interpretations.

Additionally, the researcher will observe camp activities including science instruction. As observing students during instruction and engagement in camp activities will subsequently involve indirect observation of camp instructors, classroom teachers, and parent chaperones, consent from these individuals will also be obtained. Security permission will be obtained from participants to videotape prior to beginning the study. The researcher will observe science camp activities and instruction and maintain field notes documenting activities and interactions between student participants and staff. The observations will take place for 3 weeks and will not require any additional time commitment from staff or student participants. The procedure will also involve artifact analysis of lesson plans and program materials.

4. Risks and Benefits:

Participants may experience some anxiety during interviews and observations. A member-check procedure will be performed to increase the validity of the data and reduce any anxiety participants may have about the accuracy of their responses and the researcher's interpretations. All participants will be encouraged to ask the researcher questions throughout the duration of the study and will be informed that they may withdraw from the study at any time without penalty. The research (participation or non-participation) will not have any influence on how students in the program are assessed.

The benefits may be subjects having an increased awareness of their developing identities as learners of science. It may also offer students a chance to voice their feelings toward science. Participants and parents of participants will be informed that they may withdraw from the study at any time.

5. Confidentiality:

All information collected in this study is confidential to the extent permitted by law. Students and staff members' identities will be disguised through the use of pseudonyms in all written materials. Videotapes, Audiotapes, transcripts, journals, field notes and artifacts collected during the program will remain private and will not be made publicly available. Information will not be recorded in such a manner that subjects can be identified, directly or through identifiers linked to subjects. Participants will complete interviews in a private area away from others.

This research project involves making videotapes and audiotapes of science camp activities and participant interviews. Videotapes and audiotapes are necessary for the researcher in order to present the participants' voices authentically. The videotape and audiotape data will be transcribed for analysis by the researcher. Only the researchers will have access to the video and audio files. Video and audio files will be stored on the researcher's (Riedinger) computer and will be destroyed at the end of ten years.

All data collected during the course of the research will be stored by code number at the researcher's (Riedinger) home and will be kept in a secure cabinet. Electronic copies of data will be stored on the researcher's computer. Only the researchers will have access to the data, both hard copies and electronic.

The study will take approximately eighteen months. Data will be stored in a locked secure file cabinet and on a computer hard drive at the researcher's home for up to ten years. At the end of ten years, shredding will destroy all hardcopy data; all electronic data will be deleted from all storage devices.

6. **Information and Consent Forms:**

Parent consent forms and student assent forms will be distributed prior to coming to camp, as most of the students will be attending the field trip program without their parents. Information provided to the subjects is disclosed on the letter to parents, the student assent form, and the parent consent forms (please see attached). Upon IRB approval, the letter to parents, consent, and assent forms will be sent to classroom teachers for distribution to parents and students. The Marine Science Consortium mails essential paperwork (e.g., waivers, emergency contact forms) to teachers prior to the camp program. Teachers distribute the paperwork and collect to bring with them to the field trip program. The letter to parents, consent, and assent forms for the study will be mailed with this camp paperwork. The study forms will be sent to teachers no later than 2 weeks prior to the field trip program start date. Parents and students have approximately 2 weeks to read through and complete all Marine Science Consortium program related forms for program participation as well as research related information (letter to parents, consent and assent forms). During this time, parents and students will have time in their private homes to examine the consent and assent forms.

Consent forms for teachers, parent chaperones, and science camp instructors will be distributed and collected 2 hours prior to beginning the research study. Information provided to the subjects is disclosed on the teacher, parent chaperone, and instructor consent forms (please see attached). Consent forms will be distributed during the check-in and orientation procedures that the Marine Science Consortium holds for each session before their program begins. Teachers, parent chaperones, and science camp instructors have approximately 2 hours during this time to read through and complete all Marine Science Consortium program related forms for program participation as well as research related information (consent forms). During this time, participants will have time in a private area away from the check-in desk and researcher to examine the consent. All participants will be encouraged to ask questions after reviewing the consent forms.

It will not be necessary to obtain informed consent in a language other than English as participants in this study will be speakers of English. None of the information is deceptive. Signed assent and consent forms will be stored in the researcher's (Riedinger) home until the completion of the study. Participants will be informed that they may withdraw from the study at any time without penalty. All participants will receive a copy of the consent form for their records.

7. Conflict of Interest:

There is no known conflict of interest for the participants because their identities will be protected and the research presents no threat to the Marine Science Consortium or the University of Maryland, College Park.

8. HIPAA Compliance:

This study is not using protected health information nor are the researchers employed by the University Health Center.

9. Research Outside of the United States:

N/A- Research will be conducted in the United States.

10. Research Involving Prisoners:

N/A- Research does not involve prisoners.

Participant Assent Form

To participant:

I will be studying the field trip program during your stay at the Marine Science Consortium. Your participation in this study is not required. If you choose to participate in the study, I will ask to observe and videotape you during camp activities and will ask you to maintain a camp journal. The journals may take up to 10 minutes during each day of camp (for a maximum 40 minutes). I may also ask you to talk with me as part of a group interview. There will be one interview on the first day of camp which will take 15 minutes and a second interview on the last day of camp which will also take 15 minutes. The total time that you would participate in interviews would be 30 minutes. Information from the research will be kept confidential. You will be able to complete the interviews in a private area away from others. I will change your name in my writing to keep your confidentiality. After the research is completed, I will keep the tapes and notes for up to ten years and you will still have confidentiality. No one else will have access to the data in the study. Please circle yes or no below if you agree to participate. Please write your name underneath where you circled.

Sincerely,

Ms. Kelly Riedinger

Yes No

Name_______________________________
Name_________________________
Date _________________________________ Date
____

Please check one:

___ I agree to participate in this study.

___ I do not agree to participate in this study.

Please check one:

____ I agree to be videotaped and audiotaped during participation in this study

____ I do not agree to be videotaped audiotaped during participation in this study

Initials _______ Date ______

Parental Informed Consent Form:

Project Title	***Middle school students constructing identities as learners of science through shared learning conversations at a science camp.***
Statement of Age of Subject	*Parental Permission: I state that I am 18 years of age or older and give permission for my child to participate in a program of research being conducted by J. Randy McGinnis and Kelly Riedinger in the Department of Curriculum and Instruction at the University of Maryland, College Park.*
Purpose	*This is a research project being conducted by Dr. J. Randy McGinnis and Kelly Riedinger at the University of Maryland, College Park. We are inviting your child to participate in this research project because she/he will be participating in a field trip at the Marine Science Consortium. The purpose of this research project is to investigate the ways learning conversations at a science camp guide students in constructing identities as learners of science.*
Procedures	*There are several components to the study. Your child will be videotaped during science camp activities. The videotaped observations will be used only for the purposes of research and will only be viewed by the researchers. Your child will be asked to maintain a journal during the program to document their experience. Finally, your child may be asked to participate in a group interview with some of their peers. Sample interview questions include: What have you learned most about in science this year? Do you think you do well in science? What are your strengths in learning science? What are your weaknesses in learning science? All participants will be encouraged to ask the researcher questions throughout the duration of the study and will be informed that they may withdraw from the study at any time without penalty.*

What about confidentiality?	*We will do our best to keep your child's personal information confidential. All information collected in this study is confidential to the extent permitted by law. Your child will complete interviews in a private area away from others. The data collected will be grouped with data others provide for reporting and presentation and your child's name will not be used. This research project involves making videotapes and audiotapes of your child's engagement in camp activities and responses to interview questions. Videotapes and audiotapes are necessary for the researcher in order to present the participants' voices authentically. The videotape and audiotape data will be transcribed for analysis by the researcher. The data will be stored by code number in a secured cabinet at the researcher's (Riedinger) home for up to ten years. Electronic copies of data (including video and audio files) will be stored on the researcher's computer. Only the researchers will have access to the data. The study will take approximately eighteen months. After ten years, shredding will destroy all hardcopy data; all electronic data will be deleted from all storage devices.*
What are the risks of this research?	*Your child may experience some level of anxiety through their participation in the interviews and observations. Your child will be able to review transcripts to potentially reduce any anxiety about her/his comments in the interviews. Your child may withdraw from the study at any time without penalty. The research (participation or non-participation) will not have any influence on how students in the program are assessed.*
What are the benefits of this research?	*This research is not designed to help your child personally, but the results may help the investigator learn more about science learning. We hope that, in the future, other people might benefit from this study through improved understanding of learning in informal science settings and in particular, science camps.*
Do I have to be in this research? May I stop participating at any time?	*Your child's participation in this research is completely voluntary. You may choose for your child not to take part at all. If you decide to allow your child to participate in this research, they may stop participating at any time. If you decide not to allow your child to participate in this study or if they stop participating at any time, they will not be penalized or lose any benefits to which they otherwise qualify.*

Initials _______ Date ______

What if I have questions?	*All potential participants will be encouraged to ask the researcher questions throughout the duration of the study and will be informed that they may withdraw from the study at any time without penalty. Participation in the research is completely voluntary. This research is being conducted by Dr. J. Randy McGinnis and Kelly Riedinger in the Department of Education Curriculum and Instruction at the University of Maryland, College Park. If you have any questions about the research study itself, please contact:* *Dr. J. Randy McGinnis* *Dept. of Curriculum & Instruction* *Rm. 2226 Benjamin Bldg.* *University of Maryland, College Park* *College Park, MD 20742* *Telephone: 301-405-6234* *Email: jmcginni@umd.edu*
Contact Information Of Institutional Review Board	*If you have questions about your rights as a research subject or wish to report a research-related injury, please contact: Institutional Review Board Office, University of Maryland, College Park, Maryland, 20742; (e-mail) irb@deans.umd.edu; (telephone) 301-405-0678* *This research has been reviewed according to the University of Maryland, College Park IRB procedures for research involving human subjects.*
	*Name of Parent:*____ *Signature of Parent:*_____________________________________ *Date:* ____________________

Please check one:

___ I agree to allow my child to participate in this study.

___ I do not agree to allow my child to participate in this study.

Please check one:

____ I agree to allow my child to be videotaped and audiotaped during their participation in this study

____ I do not agree to allow my child to be videotaped and audiotaped during their participation in this study

Initials _______ Date ______

Science Instructor Informed Consent Form:

Project Title	***Middle school students constructing identities as learners of science through shared learning conversations at a science camp.***
Purpose	*This is a research project being conducted by Dr. J. Randy McGinnis and Kelly Riedinger at the University of Maryland, College Park. We are inviting you to participate in this research project because you are a staff member at the Marine Science Consortium. The purpose of this research project is to investigate the ways learning conversations at a science camp guide students in constructing identities as learners of science.*
Procedures	*The procedures will include videotaped observation of staff members during activities with program participants. The researcher will maintain field notes documenting program activities and interactions between participants and staff. The procedure will also involve artifact analysis of lesson plans and program materials. All participants will be encouraged to ask the researcher questions throughout the duration of the study and will be informed that they may withdraw from the study at any time without penalty.*
What about confidentiality?	*We will do our best to keep your personal information confidential. All information collected in this study is confidential to the extent permitted by law. The data collected will be grouped with data others provide for reporting and presentation and your name will not be used. The data will be stored by code number in a secured cabinet at the researcher's (Riedinger) home for up to ten years. Electronic copies of data will be stored on the researcher's computer. Only the researchers will have access to the data. The study will take approximately eighteen months. After ten years, shredding will destroy all hardcopy data; all electronic data will be deleted from all storage devices.*
What are the risks of this research?	*You may experience some level of anxiety through you participation in observations.*
What are the benefits of this research?	*This research is not designed to help you personally, but the results may help the investigator learn more about science learning. We hope that, in the future, other people might benefit from this study through improved understanding of learning in informal science settings and in particular, science camps.*

Initials _______ Date ______

Do I have to be in this research? May I stop participating at any time?	*Your participation in this research is completely voluntary. You may choose not to take part at all. If you decide to participate in this research, you may stop participating at any time. If you decide not to participate in this study or if you stop participating at any time, you will not be penalized or lose any benefits to which you otherwise qualify.*
What if I have questions?	*All potential participants will be encouraged to ask the researcher questions throughout the duration of the study and will be informed that they may withdraw from the study at any time without penalty. Participation in the research is completely voluntary. This research is being conducted by Dr. J. Randy McGinnis and Kelly Riedinger in the Department of Education Curriculum and Instruction at the University of Maryland, College Park. If you have any questions about the research study itself, please contact:* *Dr. J. Randy McGinnis* *Dept. of Curriculum & Instruction* *Rm. 2226 Benjamin Bldg.* *University of Maryland, College Park* *College Park, MD 20742* *Telephone: 301-405-6234* *Email: jmcginni@umd.edu*
Contact Information Of Institutional Review Board	*If you have questions about your rights as a research subject or wish to report a research-related injury, please contact: Institutional Review Board Office, University of Maryland, College Park, Maryland, 20742; (e-mail) irb@deans.umd.edu; (telephone) 301-405-0678* *This research has been reviewed according to the University of Maryland, College Park IRB procedures for research involving human subjects.*
Statement of Age of Subject and Consent	*Your signature indicates that:* *you are at least 18 years of age;,* *the research has been explained to you;* *your questions have been answered; and* *you freely and voluntarily choose to participate in this research project.*

Initials _______ Date ______

	*Name of Participant:*_______________________________________ *Signature of Participant:*____________________________________ *Date:* ___________________

Please check one:

___ I agree to participate in this study.

___ I do not agree to participate in this study.

Please check one:

____ I agree to be videotaped during participation in this study

____ I do not agree to be videotaped during participation in this study

Initials _______ Date ______

Parent Chaperone Informed Consent Form:

Project Title	***Middle school students constructing identities as learners of science through shared learning conversations at a science camp.***
Purpose	*This is a research project being conducted by Dr. J. Randy McGinnis and Kelly Riedinger at the University of Maryland, College Park. We are inviting you to participate in this research project because you are a parent chaperone during your school's field trip at the Marine Science Consortium. The purpose of this research project is to investigate the ways learning conversations at a science camp guide students in constructing identities as learners of science.*
Procedures	*The procedures will include videotaped observation of parent chaperones during activities with program participants. The researcher will maintain field notes documenting program activities and interactions between participants and parent chaperones. All participants will be encouraged to ask the researcher questions throughout the duration of the study and will be informed that they may withdraw from the study at any time without penalty.*
What about confidentiality?	*We will do our best to keep your personal information confidential. All information collected in this study is confidential to the extent permitted by law. The data collected will be grouped with data others provide for reporting and presentation and your name will not be used. The data will be stored by code number in a secured cabinet at the researcher's (Riedinger) home for up to ten years. Electronic copies of data will be stored on the researcher's computer. Only the researchers will have access to the data. The study will take approximately eighteen months. After ten years, shredding will destroy all hardcopy data; all electronic data will be deleted from all storage devices.*
What are the risks of this research?	*You may experience some level of anxiety through you participation in observations.*
What are the benefits of this research?	*This research is not designed to help you personally, but the results may help the investigator learn more about science learning. We hope that, in the future, other people might benefit from this study through improved understanding of learning in informal science settings and in particular, science camps.*

Do I have to be in this research? May I stop participating at any time?	*Your participation in this research is completely voluntary. You may choose not to take part at all. If you decide to participate in this research, you may stop participating at any time. If you decide not to participate in this study or if you stop participating at any time, you will not be penalized or lose any benefits to which you otherwise qualify.*
What if I have questions?	*All potential participants will be encouraged to ask the researcher questions throughout the duration of the study and will be informed that they may withdraw from the study at any time without penalty. Participation in the research is completely voluntary. This research is being conducted by Dr. J. Randy McGinnis and Kelly Riedinger in the Department of Education Curriculum and Instruction at the University of Maryland, College Park. If you have any questions about the research study itself, please contact:* *Dr. J. Randy McGinnis* *Dept. of Curriculum & Instruction* *Rm. 2226 Benjamin Bldg.* *University of Maryland, College Park* *College Park, MD 20742* *Telephone: 301-405-6234* *Email: jmcginni@umd.edu*
Contact Information Of Institutional Review Board	*If you have questions about your rights as a research subject or wish to report a research-related injury, please contact: Institutional Review Board Office, University of Maryland, College Park, Maryland, 20742; (e-mail) irb@deans.umd.edu; (telephone) 301-405-0678* *This research has been reviewed according to the University of Maryland, College Park IRB procedures for research involving human subjects.*
Statement of Age of Subject and Consent	*Your signature indicates that:* *you are at least 18 years of age;,* *the research has been explained to you;* *your questions have been answered; and* *you freely and voluntarily choose to participate in this research project.*

	*Name of Participant:*_____________________________________ *Signature of Participant:*____________________________________ *Date:* ____________________

Please check one:

___ I agree to participate in this study.

___ I do not agree to participate in this study.

Please check one:

____ I agree to be videotaped during participation in this study

____ I do not agree to be videotaped during participation in this study

Initials _______ Date ______

Classroom Teacher Informed Consent Form:

Project Title	***Middle school students constructing identities as learners of science through shared learning conversations at a science camp.***
Purpose	*This is a research project being conducted by Dr. J. Randy McGinnis and Kelly Riedinger at the University of Maryland, College Park. We are inviting you to participate in this research project because you are bringing your class to a field trip at the Marine Science Consortium. The purpose of this research project is to investigate the ways learning conversations at a science camp guide students in constructing identities as learners of science.*
Procedures	*The procedures will include videotaped observation of teachers during activities with program participants. The researcher will maintain field notes documenting program activities and interactions between participants and staff. You will be asked to participate in an audiotaped interview on the first and last day of the program to give your perspective on students' identities as science learners. Sample interview questions include: How is (student) in science? How does (student) learn science best? Do you think he/she has confidence in their abilities as a science learner? What are (student)'s strengths and weaknesses when learning science? All participants will be encouraged to ask the researcher questions throughout the duration of the study and will be informed that they may withdraw from the study at any time without penalty.*

Initials _______ Date ______

What about confidentiality?	*We will do our best to keep your information confidential. All information collected in this study is confidential to the extent permitted by law. You will complete interviews in a private area away from others. The data collected will be grouped with data others provide for reporting and presentation and your name will not be used. This research project involves making videotapes and audiotapes of your engagement with students in camp activities and responses to interview questions. Videotapes and audiotapes are necessary for the researcher in order to present the participants' voices authentically. The videotape and audiotape data will be transcribed for analysis by the researcher. The data will be stored by code number in a secured cabinet at the researcher's (Riedinger) home for up to ten years. Electronic copies of data (including video and audio files) will be stored on the researcher's computer. Only the researchers will have access to the data. The study will take approximately eighteen months.* *After ten years, shredding will destroy all hardcopy data; all electronic data will be deleted from all storage devices.*
What are the risks of this research?	*You may experience some level of anxiety through you participation in observations and interviews.*
What are the benefits of this research?	*This research is not designed to help you personally, but the results may help the investigator learn more about science learning. We hope that, in the future, other people might benefit from this study through improved understanding of learning in informal science settings and in particular, science camps.*
Do I have to be in this research? May I stop participating at any time?	*Your participation in this research is completely voluntary. You may choose not to take part at all. If you decide to participate in this research, you may stop participating at any time. If you decide not to participate in this study or if you stop participating at any time, you will not be penalized or lose any benefits to which you otherwise qualify.*

Initials _______ Date ______

What if I have questions?	*All potential participants will be encouraged to ask the researcher questions throughout the duration of the study and will be informed that they may withdraw from the study at any time without penalty. Participation in the research is completely voluntary. This research is being conducted by Dr. J. Randy McGinnis and Kelly Riedinger in the Department of Education Curriculum and Instruction at the University of Maryland, College Park. If you have any questions about the research study itself, please contact:* *Dr. J. Randy McGinnis* *Dept. of Curriculum & Instruction* *Rm. 2226 Benjamin Bldg.* *University of Maryland, College Park* *College Park, MD 20742* *Telephone: 301-405-6234* *Email: jmcginni@umd.edu*
Contact Information Of Institutional Review Board	*If you have questions about your rights as a research subject or wish to report a research-related injury, please contact: Institutional Review Board Office, University of Maryland, College Park, Maryland, 20742; (e-mail) irb@deans.umd.edu; (telephone) 301-405-0678* *This research has been reviewed according to the University of Maryland, College Park IRB procedures for research involving human subjects.*
Statement of Age of Subject and Consent	*Your signature indicates that:* *you are at least 18 years of age;,* *the research has been explained to you;* *your questions have been answered; and* *you freely and voluntarily choose to participate in this research project.*

Initials _______ Date ______

	*Name of Participant:*______________________________________ *Signature of Participant:*___________________________________ *Date:* ____________________

Please check one:

___ **I agree to participate in this study.**

___ **I do not agree to participate in this study.**

Please check one:

____ **I agree to be videotaped and audiotaped during participation in this study**

____ **I do not agree to be videotaped and audiotaped during participation in this study**

Letter to Parents

Date

Dear ________________:

As a former educator with various informal science education programs, I have come to realize the impact that these programs can have on students' development. It is for this reason that I have chosen to study the how middle school students construct identities as learners of science during shared learning conversations at a science camp.

This letter is to invite your child to partake in this study when they attend the field trip program with their school at the Marine Science Consortium. The study will be conducted with guidance from the University of Maryland, College Park (Advisor: Dr. J. Randy McGinnis, Department of Curriculum & Instruction).

Your child's participation would consist of the following:

- videotaped observations during participation in science activities and instruction
- keeping a journal

The videotapes will be viewed only by the researchers and used only for data analysis purposes. The journals will take approximately 10 minutes per day (for a maximum of 40 minutes over the 4 day program).

In addition, I may ask your child to engage in a group interview with some of her/his peers on the first and last day of the field trip program. I expect that the interview will take approximately 15 minutes (for a total of 30 minutes).

To protect your child's confidentiality, documents will be coded and their identity will not be included in any reports. In addition, only the researcher will have access to the information. Participants of the study may withdraw at anytime without penalty.

I hope you are willing to allow your child's participation in this potentially valuable study. If you agree to their participation, please sign the parental consent form and provide the background information requested.

Sincerely,

Kelly Riedinger

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