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Family Science: An Ethnographic Case Study of the Ordinary Science and Literacy Experiences of one Family

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FAMILY SCIENCE: AN ETHNOGRAPHIC CASE STUDY OF THE ORDINARY
SCIENCE AND LITERACY EXPERIENCES OF ONE FAMILY

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DISSertation
A Thesis Submitted to The Graduate School at the University of Missouri – St. Louis in
partial fulfillment of the requirements for the degree of
Doctor of Philosophy in Education with an emphasis in Teaching – Learning Processes

December 2012

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Abstract

Despite the copious research available on science learning, little is known about ways in which the public engages in free-choice science learning and even fewer studies have focused on how families engage in science to learn about the world around them. The same was true about studies of literacy development in the home until the 1980s when researchers (e.g. Bissex, 1980; Heath, 1983; Taylor, 1983) began documenting the literacy happenings and practices of young children in natural settings. Findings from intensive emergent literacy research studies have challenged traditional approaches to the teaching and learning of literacy, especially drawing attention to the active role children take in their own learning. Drawing upon those early literacy studies, this research project uses ethnographic case study methods, along with a naturalistic inquiry approach, to document the daily explorations of one science-oriented family. Over a three year span, I followed my own family, in our natural setting, through our day-to-day experiences with science and literacy as we seek to mediate and understand the world around us. In doing so, I explored the ways we shared knowledge and constructed learning through science books and read alouds, self-initiated inquiry learning, and communication. Throughout the three year research period, I collected data and documented my own young children’s understanding of the nature of science by observing their engagement with the world around them.
Acknowledgements

My first meeting with Dr. E. Wendy Saul was at a small coffee shop in the Tower Grove neighborhood in St. Louis, Missouri. That day, I was seeking her input regarding the doctoral program at the University of Missouri, St. Louis, while inquiring about the possibility of her serving as my advisor. Later, she was to offer me a graduate assistantship and provide support throughout my entire doctoral program. After many conversations regarding a dissertation topic, Dr. Saul initiated the idea of researching my own children, a dissertation topic that I grew to love. I am forever grateful to Dr. Saul for her patience and confidence that I could succeed in this journey.

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3.1 Data Collection Tools and Types
List of Abbreviations

AAAS- American Association for the Advancement of Science

CBASSE- Commission on Behavioral and Social Sciences and Education

CILS- Center for Informal Learning and Schools

NOS- Nature of Science

NRC- National Research Council

NSTA- National Science Teachers Association
Chapter One: Introduction

In Heaths’ ground-breaking study, *Ways with Words*, (1983) she claims “...the different ways children learned to use language were dependent on the ways in which [members of] each community structured their families, defined roles that community members could assume, and played out their concepts of childhood that guided child socialization” (p.11). In other words, children learn language by being socialized in the culture in which they are immersed.

Learning is, indeed, social and cultural (Dewey, 1916; Heath, 1983; Vygotsky, 1930; 1978, Rogoff, 2003). Lev Vygotsky’s (1930;1978) socio-cultural perspective holds that culture and society are important for an individual’s cognitive development, while playing a vital role in shaping such development. Even more so, knowledge is actively constructed by the learner and is modified by the learner’s experiences of the world. Although these statements apply to all learning, they are also true in specific, subject-matter learning. Looking into the social and cultural aspects of how a child learns science, for instance, is in itself an enormous task, since science is learned in so many ways and contexts. For example, what is learned in school? In play? From the family? From books? According to Project 2061 from the American Association Advancement in Science (1993), the “characteristics of a child's social setting affect how he or she learns to think and behave, by means of instruction, rewards and punishment, and example” (p.152).

In this study I examined how one family, my own family, enacts the learning of science. In our home, as parents, we continually model our love of learning and discovery
of new things in and outside of our home; this learning, mainly focuses around our
adventures in science. We engage in science activities that we deem appropriate, but also
seek suggestions and input from our children. We are science- and nature-oriented
parents and consequently we are a family that frequently engages in science for
enjoyment, from our small backyard vegetable garden to explorations at nature centers, to
searches on the Internet, and to the books we read. At times I would select the science
activities in our home and at informal leaning centers, while at times the children would
make a request for a science adventure. All of our science activities were naturally
carried out, something we would do whether or not we were involved in my research
project. I have chosen to make learning a huge part of my children’s daily life, a learning
path that is very different from my childhood educational experiences. As parents of
small children, my husband and I agree with Harlen (1985), that learning and
understanding science supports the children's development and sense-making of the
world around them. We feel that our model of learning and discovery will help and
support our children in their educational endeavors. Nonetheless, participating in science
activities is a natural and ongoing part of our daily life.

This study is based on notes and artifacts collected as exemplars of science
engagement. These documents were collected over a three-year period and focus on our
family science learning; which is composed of sharing knowledge, self-initiated inquiry
learning, science books and read alouds, and our science conversations. Using a
Naturalistic Inquiry approach (Lincoln & Guba, 1985), I have documented our day-to-
day science encounters with extensive field notes and journaling, photographs, audio
recordings and (rarely) video recordings. By observing my family in our natural setting, I
sought to explain the contexts in which our science interactions occur, interpret such interactions, and relate them to other cognitive, social, and cultural influences. From this large data set, I chose significant incidents to serve as exemplars of the kinds of interactions that have proven effective, surprising or even problematic. My goal is to illuminate the ways in which my family seeks to promote and take advantage of science learning opportunities while exploring the world around us. These explored attempts are focused around inquiry and self-initiated learning, critical thinking and problem-solving, and sharing the family’s science knowledge with others.

Although fostering early exposure and interest in science can lead to sustained interest and possible pursuit of a science career (Tai, 2006), it is not my own nor my husband’s purpose to push our children toward scientific professions. Rather, like Ryan & Aikenhead, (1992) we believe early exposure to science, especially science ideas that characterize the field rather than a collection of facts (this is also known as “the nature of science”) can lead to basic understandings that can be built upon and developed in later years. The nature of science (NOS) is the intersection of the history, sociology, and philosophy of science that leads to an understanding of how science works, how scientists operate, and interpretations of science within society (McComas, Clough, & Almazroa, 1998). Lederman (2007) supports seven crucial components of understanding he sees as characterizing the NOS. These components include:

1. Understanding the differences between observation and inference.
2. Understanding and distinctions between scientific laws and theories.
4. Scientific knowledge is subjective and/or theory-laden.
5. Science and scientists are products of the culture.
6. Scientific knowledge is tentative and subject to change.
7. Scientific inquiry and NOS are intertwined, yet distinctly different.
NOS is commonly referred to in science education standards (AAAS, 1989; NRC, 2012) and such skills are viewed as a critical component of scientific literacy (NSTA, 1982). Yet, by the time students reach middle school, they have often developed profound misconceptions regarding NOS (Ryan et al., 1992). Lederman argues for the value of NOS as providing the understanding of science as a discipline as opposed to its concrete instrumental value. He states that it is highly unlikely that individuals will come to understand the tentative, empirically-based nature of science, which is influenced by social and cultural factors, unless it is taught in an explicit manner (Lederman, 1998).

The NOS is taught in our schools, mostly implicitly (Lederman, 1998), largely overlooking the role that informal science can play (Falk, Brooks, & Amin, 2001). One way to explore and learn science and the nature of science is through informal museums and other institutions and through activities family can do in the home. Such potential for science learning in non-school settings is often overlooked and underestimated (NRC, 2009). Through informal learning, families can engage with science and the NOS by connecting science to everyday life and exposure to the processes of science. Research available shows the public does engage with science (Durant, 1999; Falk et al., 2001), but such engagement with free-choice science learning is poorly understood (Falk, Storksdieck, & Dierking, 2007; Korpan, Bisanz, Boehme, & Lynch, 1997) and needs further research. Some estimates show individuals spend as little as nine percent of their time in formal schooling (NRC, 2010), with the majority of their time devoted to non-school settings (Bevan, Bell, Stevens, & Razfar, 2012). This substantial amount of time
not spent in schools is available for free-choice learning, which is driven by the public's own needs and interests (Korpan, et.al, 1997; NRC, 2010).

In order to investigate how a family engages in free choice learning, this study explores a family in its natural setting, which is our home, our car, our family out together in the world. Numerous researchers have studied their own children and their exposure to literature in the home setting (Baghban, 1984; Bissex, 1980; Campbell, 1999; Cook, 2005; Greenlee, 2007; Maduram, 2000; Mikkelson, 2005; Rowe, 1998; White, 1984; Wolf & Heath, 1992). These home literacy studies documented the early literacy interactions and provided significant contributions to literacy studies, early childhood development, and teaching and learning. Other researchers have studied family literacy (Heath, 1983; Taylor, 1983; Teale, 1986), exploring the dynamics of parent-child literacy happenings in the home, again making significant contributions to literacy research. Little work, however, has been undertaken to explore science literacy practices within a family setting.

In our family, we explore the world around us by capitalizing on learning opportunities in and out of the house. In our yard, we plant seeds, flowers, and various landscaping plants together. We find, explore, and observe insects and birds around our yard. Inside our home, we read nonfiction literature on topics we find interesting while seeking information and answers to our questions and observations. At the onset of this study, while living in our home in St. Louis, we explored numerous parks, such as walking to the neighborhood park, approximately a half mile from our home, to play on the equipment, play in the open fields, and cut bamboo stalks that spread into the park from neighboring private property. Many of our outings included trips to explore the
county parks surrounding our neighborhood. Other outdoor explorations included nature centers, conservation areas, and state parks all within a short drive from our home. One such nature center included many indoor exhibits and paved walking trails, where we could observe native organisms and habitats, while providing educational programming. We would often participate in or take advantage of the educational activities present.

After two years into this study, my family moved to a small, rural community in Northeastern Missouri. Here, I began work as an Assistant Professor of Education at a small liberal arts college, while the children entered a new public schooling system. Although the community resources changed, limiting our exposure to parks, nature centers, and cultural institutions, we were able to keep science alive through books, media, and in and out of our new home.

With that being said, informal institutions are an important learning aspect. Living in a mid-size city, we were within a very short driving distance to a wide variety of cultural institutions, which were free and/or relatively inexpensive to visit. We frequently took advantage of trips to the local zoo, science center, botanical garden, and other museums in the area. With such a wide variety of science and cultural institutions in that urban area, we have been afforded the opportunity to participate in free choice science learning that others may not encounter.

Being a researcher in my own home has its advantages, referred to as insider research, meaning the researcher is directly involved and connected to the research setting (Robson, 2002). I am present for almost everything—listening, talking, observing, probing, and questioning—during the majority of the nonschool time. In short, I can acquire the insider information that many researchers cannot. Insider research greatly
contrasts with traditional notions of research in which the researcher is an objective outsider (Denzin & Lincoln, 2000). Denzin and Lincoln (2000) note the importance to disclose the insider researcher’s prior knowledge, underlying personal bias, and preconceived notions.

**Guiding Questions**

Throughout this study the guiding question has been:

- How does my family foster science learning?

The following sub-questions will aid in my efforts for collecting data in guiding my research:

- What are the ways we participate in and interact with science on a day to day basis?
- How is science shared and portrayed?
- How is sense-making experienced by the family, mainly the children?

All guiding questions are bounded around our interactions with science; explorations of the world around us.

**Limitations**

This research study is based on data collected from April 16, 2009, to April 16, 2012, in and out of the family's home, including various informal settings and through our traveling adventures. Informal settings include public libraries, museums, nature centers, nature reserves, and backyards, but not limited to those types of informal settings. As an insider, I had many advantages of obtaining data that outside researchers may not be able to obtain due to limiting factors. For three years, I have collected data through the interactions of my family. Data which an outsider researcher may not have access to therefore limiting their study. Whereas outsider research is able to provide a
macro analysis of daily scientific encounters, I have been able to provide a rich microanalysis of my family's science encounters.

Challenges to being an insider researcher on my family’s science interactions, includes being close to the family and the issues at hand. Seidman (1991) suggests that being sensitive to issues and taking them into account throughout the study, while “interviewing requires interviewers to have enough distance to enable them to ask real questions and to explore, not to share, assumptions” (p. 77). Both parties, involved in the research project, bring biases, attitudes, physical characteristics, and predispositions that may affect the interaction and the data brought forth (Merriam, 2009). Thus, “taking a stance that is nonjudgmental, sensitive, and respectful of the respondent is but a beginning point in the process,” (Merriam, 2009, p. 109) in reporting the findings of the research project.

In order to combat the challenges brought about for this insider research project, I carefully planned the project to follow our daily lives, in a naturalistic way, to highlight science and literacy learning that will inform parents, childcare providers, schools, and researchers about the ways young children can engage with science and literacy. Although great care and effort has been taken, I am still aware of the limitations due to the small sample size, being only one family. Therefore, for the study to be generalized to larger groups, more families and/or individuals would need to be studied. Lastly, with my background being in literature and science, this could pose as a limitation to others families that do not have the same expertise. Meaning, my family’s educational background may not be typical of the average family. This case study will highlight and
explain the ways that science and literacy can be addressed by families who encourage and engage in free choice science experiences as a family.

**Definition of Terms**

- **Science.** Discovering and learning about the natural and physical world around us.

- **Science Learning.** Science learning is multifaceted; research on science learning involves a wide range of interests, attitudes, knowledge, and competencies (NRC, 2010). Science learning moves beyond the memorization of facts to include understanding, interest, engagement, reflection, and the processes of science.

- **Science literacy.** According to Project 2061, science literacy requires understandings of science, mathematics, and technology, making sense of the world, thinking critically and independently, and recognizing and dealing sensibly with problems and issues (AAAS, 1993).

- **Scientific literacy.** Defined as one's ability to "ask, find, or determine answers to questions derived from curiosity about everyday experiences" (National Research Council, 2012).

- **Nature of Science (NOS).** Lederman (1992) describes NOS as the epistemology of science, science as a way of knowing, or the values and beliefs inherent to scientific knowledge and its development. Whereas the AAAS (1993) puts emphasis here for young children on "gaining experiences with the natural and social phenomena and on enjoying science" (p.4). Furthermore, they should be doing science, i.e., investigations, observations, explaining thoughts and answers, and in the later years, they can build and expand upon these experiences.
• **Engagement.** When we are actively participating, interacting, talking, reading, and watching science in our everyday experiences, designed spaces programs, and science media; with the intentions of learning about the world around us.

• **Designed Spaces (Informal Environments).** Include all areas besides formal schooling. For this research study, it will include areas such as public libraries, outdoors, nature centers, science museums, botanical gardens, and so forth. While these areas are structured by the institution, "the nature of the learner's interaction with the environment if often determined by the individual" (NRC, 2009, p.48).

• **Science Media.** Includes radio, television, the Internet, and hand-held devices (NRC, 2009).

• **Dialogic system.** According to Freire (1970), one must be able to transform their lived experiences into knowledge and to use the already acquired knowledge as a process to unveil new knowledge," (p.19) including the conversation around the science must be equal, not displaying levels of power and authority between the educator/parent and the student/child.

• **Everyday and Family Learning.** Learning that occurs throughout an individual's life, such as "family or peer discussions and activities, personal hobbies, and mass media engagement and technology use" (NRC, 2009, p.47).

• **Family literacy.** Children begin the process of learning to read long before they enter formal schooling (Teale & Sulzby, 1986) whereas research has shown that children that have multiple opportunities to read and write become better readers and do better in school (Bissex, 1980; Taylor, 1983; Teale, 1986). Family literacy
incorporates all interactions of literacy, such as reading books, telling stories, writing, and singing songs.

- **Sense making.** Explaining and providing meaning to our science experiences.

- **Insider Research:** The researcher is directly involved in the research study (Denzin & Lincoln, 2000).

- **Literacy.** Language in its written form (Kress, 1997).

- **Emergent Literacy.** Children’s reading and writing development in the early years, before formal schooling (Teale & Sulzby, 1986).

- **Situated Learning.** Learning that takes place in the same context in which it is applied; a social process where knowledge is co-constructed (Lave & Wenger, 1991).

**Significance of the Study**

This study aims to find overlap in the following areas: science engagement and science-related literacy, meaning-making, situated learning, socio-cultural learning, and child development. The findings from this study will aid educators, parents, and other caregivers, envisioning the possibilities for engaging young children in science and literacy, as well as ways to engage families in science learning and understanding. This study will give us insight into the thoughts and interactions of young children, and shed light on the development of science literacy within families.

**Structure of Study**

This study includes the following chapters. Chapter 2 includes the literature review of the role of literacy learning in the context of the home and science inquiry. Chapter 3 describes the methods used for this ethnographic case study. Chapters 4, 5, and
6 include the data collected from the study. Chapter 4 focuses on the use of science books in our home; chapter 5 includes the children's self-initiated science learning; and chapter 6 focuses on our science communication. Finally, in conclusion, the last chapter of the dissertation summarizes the core of our experiences that were constructed through our day-to-day interactions and engagement in science and literacy and makes suggestions regarding future research.
Chapter Two: Review of Literature

My view of science learning is influenced by both home and family literacy with a keen interest in science and science related literature. Therefore, the literature review begins in home and family literacy, and then moves onto making the connection to science learning by observing the natural world in which children’s own curiosity guides their inquiries.

Literacy

Researchers have determined literacy learning is a social process (Baghban, 1984; Bissex, 1980; Campbell, 1999; Cook, 2005; Greenlee, 2007; Heath, 1983; Maduram, 2000; Mikkelson, 2005; Rowe, 1998; White, 1984; Wolf & Heath, 1992), and furthermore, literacy is much more than the act of reading and writing (Clay, 1966; Dyasi & Dyasi, 2004; Freire, 1970; Gee, 2001; Heath, 1983; Kress, 1996; Teale & Sulzby, 1986). Historical studies about literacy in the home includes researchers studying their own children (Wolf & Heath, 1992; Baghban, 1984; Bissex, 1980; White, 1954), which have linked the reading of books to children in the home to early literacy and success in school. Modern early literacy research studies by parent researchers and authors have portrayed their own children’s literary development, including parent-child interactions with books as well as the role that literature played in their lives (Greenlee, 2007; Schwartz, 2004; Maduram, 2004; Campbell, 1999; Rowe, 1998). Findings from these intensive research studies of emergent literacy have challenged the traditional approaches to the teaching and learning of literacy by drawing attention to the role of home-school partnerships and the active role children take in learning.
These foundational works and especially those of Freire give rise to views on literacy as a dialogical process. According to the “New Literacy Studies” perspective (Gee, 1996; Street, 1995), literacy cannot be simply described as reading and writing (Gee, 2001), but rather people maneuvering different “ways with printed words” within different sociocultural practices for different purposes and functions (Gee, 2001; Heath, 1983; Street, 1984). In these sociocultural literacy practices, humans are always meaning producers, not just meaning consumers (Kress, 1996). Within the practices of literacy, an individual’s written and spoken words are always integrated within the “ways of talking, thinking, believing, knowing, acting, interacting, valuing, and feeling associated with specific socially situated identities” (Gee, 2001, p.30).

**Home Literacy Studies**

Home based literacy studies have given rise to significant changes in the approaches used in the teaching and learning of literacy for the younger years, such as the dialogical nature of learning. Dorothy White (1954, 1984), a mother and librarian, documented the storybook readings between herself and her daughter, starting at the age of two and concluding one month before her daughter began formal schooling. The author-researcher, Dorothy, being a librarian by trade was able to capitalize on her knowledge and love of literature; providing her daughter, Carol, with a rich storybook environment. White’s writings and interpretations provide the reader with a short summary and critique of each book the two encountered, the details of Carol’s responses, and the meaning making between the language present in the books they read and the events and language of Carol’s world. Carol’s interactions and reactions to the storybook readings and discussions are documented throughout. Through this analysis, the author
depicts the ways that literature supports and influences the young child as the child experiences the world around her, which in turn continually impacts her interpretations of her world.

In another groundbreaking home literacy study, Glenda Bissex (1980) chronicled the literacy development of her young child, Paul, providing understanding to how children develop reading, writing, and oral language skills. The parent-researcher documented Paul’s invented spelling system, in which he became a fluent writer before he was a fluent reader. Eventually she documented and analyzed the intersection of the two, reading and writing. Bissex further documented the interest behind our own writing endeavors; stating that our writings often reflect upon our “individual differences as well as sex and developmental status” (p.110). Bissex noted her own differences and writing preferences to those of her son during this same developmental period. Where she mainly preferred fictional and personal experiences, her son’s writings were predominantly informational. Through her work, Bissex provided many educational implications for literacy development for young children, such as illustrating linguistic and written language constructs develop concurrently.

Continuing with the theme of reading and writing, Baghban (1984), a parent-researcher and author studied the reading and writing of her daughter from birth to age three, where she noted the social nature of reading and writing. Wolf & Heath (1992) followed Wolf’s two young daughters as they made meaning of the stories, mainly fictional, they encountered and the world around them.

Due to those groundbreaking literacy studies (Bissex, 1980; White, 1954/1984) home literacy studies still prevail. For example, more recently, Robin Campbell (1999),
literacy professor and researcher, observed the literacy happenings of his granddaughter from birth to school. Campbell noted that his granddaughter developed as a reader and writer through her involvement with literacy not through direct instruction. He suggests young children be given ample opportunities to experience meaningful reading and writing activities, have abundant print materials, and to read and listen to stories, all while giving appropriate attention and encouragement (Campbell, 1999).

In a research study by Greenlee (2007), the author and researcher kept field notes throughout the ten years during her own children’s preschool and elementary years to record the spontaneous reactions and discourse that happened in their daily lives apart from the reading of the text. In other words, this parent-researcher was interested in what occurred after the reading of the text, perhaps in the days to follow after a read aloud. Through the nonfiction literature the author’s children were able to make connections between the books and their lives. Greenlee provided two informational text examples in which her children were able to make text to world connections from their interactions with a science text and a biography text. In one such example, the child involved in the study had read a biography about the man who first translated Egyptian hieroglyphics. The child was so inspired by this book that he later completed a homework assignment using the same hieroglyphics (in which the classroom teacher had him do the assignment over in English). Greenlee concluded the study by stating that she believed literature was much broader than an educational tool.

In another study, the researcher recorded parent-child read alouds of informational texts from the child’s age of three to six years (Maduram, 2000). Maduram’s research study chronicled the range and complexity of the discourse during
the read aloud events of informational texts and the learning that followed. This parent researcher justified that being immersed in the daily family interactions; she was able to record spontaneous interactions and further discussions around the informational text that an outside researcher may not have the opportunity to observe. Through the author’s observations and field notes, she concluded that preschool children are “capable of and interested in initiating dialogues that concerned the facts presented in information books” (p.396).

**Outside Researchers Studying Home Literacy**

Other researchers have studied family literacy outside of their own homes (Taylor, 1983; Teale, 1986). In one such example, the author and researcher Teale (1986) used a naturalistic inquiry approach (Lincoln & Guba, 1985), in order to observe the everyday literacy occurrences in the home providing a “truly comprehensive description of home literacy background” (p.174). Teale and his colleagues made observations in the homes of 24 preschool children from low socio-economic status (SES) over a period of three to 18 months, in order to broadly investigate their home literacy experiences. A wide variety of literacy opportunities were noted, from little to no print materials in the home to a home filled with print material, from very little time devoted to reading and writing to much time devoted to the activities, and so forth. The one feature that stands out in each of the homes observed is the social nature of the literacy events. In the conclusion, Teale claimed that all children, even low SES, have numerous sources and exposure to literacy events, with the majority of the events being social in nature; meaning that the activities were centered on the lives of the family and their needs, not around literacy itself. Teale observed literacy is a “social process and a cultural practice”
Storybook reading was not very prevalent in the homes being studied; frequent readings occurred in three out of the 22 homes. The children in these three homes were among the highest in emergent literacy abilities. These results “reaffirm the long-standing contention that storybook reading experiences further children’s literacy development” (p.196).

Denny Taylor focused her research on family literacy (Taylor, 1983; Taylor, 1993; Taylor & Dorsey-Gaines, 1988; Taylor & Strickland, 1986). Taylor (1983) documented the early literacy happenings among six different families. To be included in the study, the parents of each family deemed the child as successful in the process of learning to read and write. Here, she noted the significance of family contributions in becoming literate and how literacy contributes to the social organization of the everyday lives of the families. Next, Taylor’s book, From the Child’s Point of View (1993), focused upon the significance of including children in the discussions and development of educational programs and learning. When children’s voices and experiences are removed, including the separation of learning from their own lives, then the child ultimately suffers the consequences. In our educational system, “we continually underestimate the enormous potential of children to participate in the construction of their own learning environments” (p.31). In Growing up Literate: Learning from Inner-City Families, Taylor & Dorsey-Gains (1988) used ethnographic methods while observing young, poverty-stricken African-American children who were successful in their literacy endeavors. Lastly, Taylor & Strickland (1986), explored the dynamics of language, literacy, and learning through family storybook readings. The authors stressed the importance of book sharing, for learning as well as the social and cultural aspects.
Bridge to My Interests

By delving into the readings and research of family literacy, I began to notice the learning occurrences and potential in my own home. As parents of two young children, my husband and I were continually sharing literature and learning opportunities with our young children. For example, on vacations and trips, we would develop a family journal, incorporating maps, photos, illustrations, descriptions, and reflections about our adventures. And as a professional in education and science, I would capture and capitalize upon science opportunities in and out of our home, sharing my love of science books during our daily and nightly read alouds. With my budding research interests began developing due to my participation in a doctoral degree, I began to wonder how I could relate these home literacy studies to my own family with a science learning and science literature twist. Professionally, my involvement in a certification program with the Center for Informal Learning and Schools (CILS) broadened my interest in the learning potential of informal environments and rich learning opportunities that existed. While participating in the many activities at CILS, I began to broaden and refine my interest and understandings of inquiry teaching and learning, while making connections between formal and informal science learning.

As I began to reflect upon my professional and personal life, I started asking myself questions…What would happen, if I explored science in the home setting? In what ways does a family read, select, and use science informational books as a natural part of learning and sense-making? As parents, how would using an inquiry approach impact our science explorations? And, most importantly, what would home literacy studies portray if the focus was on science and science learning?
Inquiry

One of the most celebrated educator/philosophers of the 20th century, John Dewey, made strong claims towards inquiry, stating “[inquiry] is the only authentic means at our command for getting at the significance of our everyday experiences of the world in which we live” (Dewey, 1938). For Dewey, he believed children should learn from their direct experiences and cultivate their natural curiosity.

Still, others focus on the importance of inquiry learning. In Freire and Macedo’s *Pedagogy of the Oppressed*, they declare the importance of reading one’s world.

*The act of learning to read and write has to start from a comprehensive understanding of the act of reading the world, something which human beings do before reading the words. Even historically, human beings first changed the world, secondly proclaimed the world, and then wrote the words. These are moments in history. Human beings did not start naming A! F! N! They started by freeing the hand, grasping the world. All children read the world first, and then read the word* (Freire & Macedo, 1987).

According to Freire and Macedo, all individuals read the world long before they even begin to read the word. From their historical perspective, an individual reads the world, talks about the world, and lastly, reads the written word. From infancy, we learn to understand the world around us through our socialization with others and the culture we are immersed in. People must have knowledge of the world, before they are able to begin decoding the written word or language. Consequently, even before we learn to read and write the word, we are already “reading,” well or poorly, the world around us (Freire & Macedo, 1987). According to Freire, it is impossible to separate the two, reading the word and the world. All individuals must be able to converse about their world first, then read and write about their world.
Reading the world, our natural inquiry to uncover information about the natural world illustrates the innate curiosity of a child. Drawing upon the work of Freire and Macedo (1987), Dyasi & Dyasi (2004) claim in *Literacy: Reading the Word and the World*, children read the world first, and then read the written word. Thus, a child’s direct experiences with the world are ideal starting places when learning about science. Almost immediately, all children investigate their surroundings and make observations; they formulate questions, collect data, and draw conclusions, using science inquiry and process skills while reading their world. Before children know what science is and/or what scientists are supposed to do, they are acting and doing science on their own. Children, as with all scientists, eventually need to read and write about these experiences, using their own words developed from their worldly experiences, not the words of the teachers and other adults (Dyasi & Dyasi, 2004), to make sense of their observations.

**Science Inquiry**

*Science inquiry refers to the diverse ways in which scientists study the natural world and propose explanations based on the evidence derived from their work.*

*Inquiry also refers to the activities of students in which they develop knowledge and understanding of scientific ideas, as well as an understanding of how scientists study the natural world* (National Research Council [NRC], 2012).

According to the National Science Education Standards (NRC, 1996), inquiry is central to science learning: “students describe objects and events, ask questions, construct explanations, test those explanations against current scientific knowledge, and communicate their ideas to others” (p.23). Inquiry, an approach to learning and
understanding science, should closely mirror the real scientific world, meaning doing real science (Dyasi, n.d.; Dyasi & Dyasi, 2004; Harlen, 1984; NRC, 2000; Saul & Reardon, 1996; Worth, n.d.; Worth & Grollman, 2003). Dyasi (n.d.) claims children have much to gain by learning through inquiry, whereas a child’s engagement with science inquiry provides ample opportunities to receive accurate feedback directly from their experiences. Children will first make observations about the world around them. These direct experiences, through the inquiry process of asking questions, seeking answers, and sharing their knowledge with others; a child is able to support their own development through inquiry (Dyasi, n.d.).

**Summary**

Research and data about science learning, i.e., the use of books, television programs, games, and the Internet, could illuminate how people learn science (Korpan, Bisanz, Boehme & Lynch, 1997). In other fields, e.g. reading and writing, research surely has (Baghban, 1984; Bissex, 1980; Clay, 1966; Heath, 1983; Rowe, 1998; Taylor, 1983; Teale & Sulzby, 1986; White, 1984; Wolf & Heath, 1992). Even more so, the amount of research available in early literacy and the general use of literature in the formal and the informal education sector are quite significant, although the use of science text and media is one area that has not been explored and researched extensively (NRC, 2009). For my purposes, I draw upon the ideas from home literacy studies (Bissex, 1980; Taylor, 1983; White, 1984/1954), literacy (Gee, 2001; Freire, 1970; Freire & Macedo, 1987; Heath, 1983; Kress, 1996; Street, 1984), and science inquiry (Dyasi, n.d.; Dyasi & Dyasi, 2004; Harlen, 1984; National Research Council, 2012, 2000, 2009, 2010; Saul & Reardon, 1996; Worth, n.d.; Worth & Grollman, 2003) for my research in family learning in
science. By combining the frameworks of family literacy and science inquiry, I will find the intersection of my family's engagement in and learning of science in and out of our home. This will aid in the understanding of science engagement and learning in the home for young children.
Chapter Three: Methods

In this chapter, I discuss the methods used in conducting a qualitative research study. This qualitative ethnographic case study of how my family interacts and engages with science and literacy on a daily basis, provides an important lens into how socio-cultural learning impacts science understanding through science activities, science talk, and the science learning that occurs due to such exposure, interactions, and engagement. From April 16, 2009, through April 16, 2012 (three years or 1,096 days), I was potentially present to collect data on my family, hence painting a picture of the science happenings in our home and the connections that were made around our explorations of the world around us.

Research Design

Ethnography is combined with case study design to illuminate the role of literacy in science learning. Creswell (1998) describes ethnography as the "description and interpretation of a cultural or social group" (p.58). Furthermore, providing a “rich, thick description is a defining characteristic” (Merriam, 1998; Stake, 1995) of ethnography. At the center of ethnography is this “thick description,” coined by Geertz (1973). Although providing this thick description is essential to ethnography, researchers do convey meanings of the participant’s role, which is done through researcher interpretation (Wolcott, 1999). Thus, with ethnographic research being both the research process and reporting the final product, ethnography is both a process and a product (Merriam, 2009).

Throughout the research study, I have woven my own childhood and thoughts into the current culture of my family. I have created a picture of the ways in which my family interacts with science by recording our day to day happenings around literature,
media, informal environments and collecting artifacts that we have created. We have used science books, science videos, and the world around us to create stories, journal entries, and take photographs of our surroundings. Capturing my family’s science activities has enabled me to provide a rich description of how one family casually interacts with science and literacy. This is an ethnography study because the intent is to provide a thick description of my family’s everyday life and practice (Merriam, 2009; Wolcott, 1999) in science, along with interpretations and conclusions. Further, I have used our science cultural lens to make meaning of different phenomena.

Case study is the framework in which the ethnography occurs. Merriam (1988), states that the case study “is an exploration of a ‘bounded system’ or a case over time through detailed, in-depth data collection involving multiple sources of information rich in context” (p.27). Merriam further describes a case study as an end product (author’s emphasis), which provides an intensive, holistic narrative of one phenomenon over time. Stake (1995) places emphasis on the case itself, meaning the unit of study, where boundedness and activity patterns nevertheless are useful concepts for specifying the case. In this research study, the case being observed is the interactions of my family as we naturally engage with science and literacy throughout our daily lives, occurring at our home, informal settings, in our car, and through our travels. This research study does not include observations in the formal school settings, although inferences can be made from the artifacts and talk around the happening in school and childcare settings.

In alignment with ethnography and case study methodology, multiple sources of data, including field notes, audio and video recordings, family journals, photographs, and family created artifacts have been collected and studied throughout the inquiry.
investigation (Merriam, 2009). Initially, I began collecting data on our read alouds, conversations, and visits to informal institutions around the family’s science and literacy interactions. With initial coding and reflection on the data collected, I streamlined my data collection to items within these categories: science literature, self-initiated inquiry, and science talk. With all subsequent data collected, I used the constant comparative method, which continually compares segments of data to one another to determine similarities and differences (Merriam, 2009).

**Context**

All participants involved in the study reside in the same household, and are of European-American descent. The members all lived in an older suburb of a mid-size city in the Midwest throughout the majority of the data collection. The last year of the study, the family moved to a small, rural community in the Midwest, as I began teaching at a small liberal arts college. The participants include the two young children (Sean and Keara), their father (Denny), and the mother-researcher (Glenda). At the onset of the study, Sean is age 7 and in first grade, while Keara, age 3, is provided part-time care in an individual’s home and eventually will attend part-time preschool at the University associated with the mother’s schooling. Both parents are college educated. While my educational background does include both science and literature, the father’s educational background does not include those two areas. Together, as parents, we have immersed both children in a wide variety of literature and stories since birth.

My professional background, including both science education and literature, and my personal and family views have led me to this research area, therefore the inclusion of my interactions with the participants of the study will add to the richness of this study. In
Lincoln & Guba's (1985) book, *Naturalistic Inquiry*, they included six justifications for the inclusion of the researcher’s interactions. These are:

1) *Theories and facts are not independent*... 2) *Purposeful sampling and emergent design are impossible to achieve without interaction*... 3) *To move beyond “mere” objectivity requires a level of mature judgment that can be achieved only by continuous interaction*... 4) *Human research is inherently dialectical*... 5) *Meaningful human research is impossible without the full understanding and cooperation of the respondents*... 6) *It is the quality of interaction that provides the human instrument with the possibility of fully exploiting its own natural advantages* (pp. 101-105).

With that being said, my area of expertise may allow me to recognize components of the research that could possibly go unnoticed by researchers with different backgrounds and/or researchers not deeply immersed in the lives of the participants.

Such, the next segment of the paper discusses the family's background, goals, and beliefs.

**Family Background**

Our family consists of two adults and two young children, all residing in the same household that is located in a suburb of a mid-size Midwestern city. The participants, two young children, Sean whose age at the beginning of the research was 7 years while Keara was three; the father, Denny; and the parent researcher, Glenda -- all are real names. Sean attends elementary school in a public suburban school, while Keara is provided care on a part-time basis by an individual in her own home and is enrolled part-time in preschool. Keara’s childcare provider is the same one who Sean stayed with on a full-time basis beginning at the age of two years. Although I think of the provider as a family member, she is of no relation to our family.
Childcare Provider

Barb Smith, the children’s childcare provider has been an educator for 32 years. The first eight years, she taught four year olds and afterschool care at a childcare center. For the next 24 years, she has provided childcare in her home. Entering Barb’s older home one can’t help but notice the overwhelming feeling of being at your Grandma’s house. The house is filled with rugs, knick knacks, and smells of food. She has toys and books hidden in closets, storage bins, and on shelves. Barb provided childcare in an educational atmosphere by incorporating projects throughout the day. These projects included the typical arts and crafts, as well as book making, cooking, building, and exploring her enormous back yard. When I asked Barb how she felt she would include science in the children’s day, she stated, “Oh, I don’t teach science lessons… I think science is all around this house… in the way we measure when we are cooking, the way we look at clouds and rainbows, colors, shapes, building, germs, oh, yeah, when they sneeze we talk about germs”… and continued on for five more minutes about her adventures with the children in her home.

Parenting thoughts and beliefs

Denny and I believe that parenting is not an easy task, and we do not take the role lightly. We try to provide for our children in every way, ensuring all needs are met. We want to make sure our children are exposed to many different things in this world that will help them educationally and we do our best to guarantee them success in school and life; all while having fun and spending time together. We especially want our children to ask questions, look at information from many different angles, and make sound decisions about the world around them, ultimately, to read the world carefully and thoughtfully. As
parents, we feel reading the world provides the children with the basic foundational experiences that will aid them in their future learning, literacy, and decision making.

We began reading aloud to them before they were ever introduced into the world. We have provided a house full of children’s literature, puzzles, and manipulatives. As a family, we have taken trips to various informal learning places and museums to ensure our children are exposed to a wide variety of educational opportunities, but most importantly, we have given our children a choice and voice. They do not have to be quiet and invisible; they ask questions and talk. This parenting technique aligns with my beliefs about learning in general.

We strongly believe that our role as parents are to provide everything, meaning the support, guidance, and security for our children’s educational needs. As parents, we both help with homework, support drawing, reading, writing, and experiments, and always seek to be encouraging. We enjoy hearing our children’s explanations of the world around them, and use their perceptions mainly to engage and interact with them. It is a very exciting time when they finally "get it!" We both read to our children almost daily, while Denny is the “expert storybook reader” in our household. Watching Denny read stories with the children is captivating, both for the listeners and the watchful eye of the observer.

I was interested in this study because it is a natural extension to our family’s usual routine and activities, as well as my beliefs as an educator. As a educator, I fully support inquiry and a hands-on, exploratory method of teaching and learning, while using many resources to support learning. Inquiry learning supports the asking of questions, searching for answers, and sharing that knowledge with others. I have followed this educational
theory as part of my parenting practices. I do not support rote memorization in the learning of our children. Our engagement in science, on a daily basis, involves reading science books, visiting museums and other informal learning environments, and watching science videos, while talking and engaging in our children’s educational endeavors, which is not dependent upon this research study. Meaning, free-choice science learning is something we would do anyway. I believe, as a parent, you should provide and promote many educational opportunities for children in preparation of their formal schooling years, lifelong learning and ultimately for a global society.

**Sean**

Sean is a complex character. He can be highly introverted yet quite bold with his words all at the same time. At times, he can seem extremely shy around others, yet he articulately voiced his opinions and demands. For example, while observing Sean at a wedding reception, Sean stayed back along the edge of the dance floor to observe others. He tapped his foot and slightly moved his body to the beat of the music. By watching Sean’s expressions and mannerism, one might assume he was eager to enter the dance floor with others. After Sean had observed for a long period of time, he finally moved out on the dance floor and dance to every song thereafter. I have observed this type of behavior in other social situations; his reluctance to participate in the activity with others until he is ready.

As a young child, Sean rarely used baby talk even as a toddler, seeming more adult-like in his conversations. Although he was well spoken, Sean rarely engaged in conversations with other adults outside of our home until he was five years old. He is extremely inquisitive with strong emotions about his likes and dislikes, at times saying
and acting inappropriately and being perceived as a little different. Sean has had trouble obeying the rules or playing the game when it comes to school lessons and social games that he deems trivial or meaningless. As a parent, you want your children to be themselves, seeking individuality, albeit society’s need for conformity causes a parent to be cautious in hopes that your children are not ridiculed and/or deemed a failure for being themselves.

During the study, Sean attended third grade in a public suburban school district. Academically, he is a strong student, yet struggles with social and maturity issues and at times boredom with the routine of worksheets and rules. Sean's classroom teacher frequently had to remind Sean to stay on task during their daily two-hour writing and reading block.

The school structure was highly traditional, with long periods devoted to reading and writing blocks, only leaving the classroom for music, art, library, and physical education. Other subjects such as science and social studies were taught using a textbook. Sean often becomes frustrated with not achieving perfection in his work and behavior, often not taking risks and/or giving up easily. At times when first introduced to a new activity, Sean expected to instantly do well and achieve expert status. For example, after receiving a skateboard for his birthday, he believed he could do the same tricks as those performed by experts he saw on television. Although I have had many discussions with his current and previous teachers regarding his misbehaviors and frustrations with school work, he rarely displays this type of behavior in any of our free-choice learning activities and adventures. He is often a leader among his neighborhood friends and playmates. His
personality can seem very dominant by organizing and instructing playmates during play time.

Sean has gravitated to science throughout his life, often asking many questions while engaging with the world around him. I remember being in a small backyard pool when Sean was about 5 years old when he asked another young girl about her favorite animal. The girl only recalled common household pets, yet Sean vividly recollected several of his more exotic favorite animals including Philippine Eagles, Orcas, and Bearded Dragons. He frequently selects science books, mainly nonfiction, during quiet times and for read-alouds. More recently, I have selected and read nonfiction science trade books to supplement the textbook science curriculum at his elementary school.

**Keara**

Keara, the younger of the two children, is more outgoing and social, yet she can be very emotional and dramatic. She often speaks louder than Sean and interjects her comments before he is able to and at times answering questions for him. Keara is friendly to others and often interjects “hello” and initiates friendly conversations with strangers that we encounter. On numerous occasions, Keara will tell females how beautiful they look, while commenting on their pretty shoes, nail polish, hair, jewelry, and so forth; mainly comments pertaining to beauty and fashion.

She absorbs information quickly and rarely selects science books for her personal enjoyment. When at the library or bookstore, I will often try to entice her with science books. She refuses them, preferring anything with a princess. Once, while visiting a consignment shop in our neighborhood, I found the book, *Actual Size* by Steve Jenkins. Knowing the book is really great and would add to our science book collection, I tried to
get Keara to purchase the book. She flatly refused and spent her time at the jewelry cases. I did purchase the book and read it to the children that evening, and both children found the book fascinating.

Keara occasionally does engage in science, yet she is determined to bring her princess identity along. As illustrated in a subsequent chapter, Keara devised an experiment she initiated with the making of rock candy, all being done with a princess cup! As parents, we have chosen this science identity for our family; it has only been recently that Keara has initiated some science on her own. In her case, the princess identity is what she associates with.

Denny, Parent

Although Denny and I grew up in the same geographical area within ten miles of one another, we did not attend school together nor did we know one another and our families did not have the same social circles. Denny is the eldest of two, growing up in a very structured and firm home, where their routine rarely shifted from nightly dinners, chores, and church on Sunday. As a child, Denny remembers literacy being important in their home; he recalls being read to occasionally and currently owns a few of his childhood books that he often shares with the children. He does not recall engaging with informal learning environments other than his involvement with the Boy Scouts of America program, in which he advanced to the Eagle Scout rank. He feels that learning came easily to him, although he was rarely encouraged to go beyond average. He stated that his mom felt he was "good at science," and he always did enjoy science, in and out of school.
Denny’s educational background includes a Bachelor's degree in Criminology and Criminal Justice, although he feels he went to college without giving it much thought. As he said, “Everybody goes to college and that is what you are supposed to do;” this is a feeling he developed from his public high school and friendships formed there.

Denny stated he personally encourages our children to learn and interact with science because he likes to hang out with them and wants to provide a wide range of learning opportunities. He feels it is important to provide informal learning opportunities for the children because he does not recall such experiences while growing up with his own family, something he feels he missed out on (Field Notes, 05/04/2010).

**Glenda, Parent and Researcher**

I was born into a rural, Midwestern young family with little to no money and very limited educational exposure and opportunities. Although my father did graduate from high school, my mother dropped out of high school when she was pregnant with her first child, my older sister. Many of my aunts and uncles do not have high school diplomas and my maternal grandfather was illiterate, having to stop formal schooling after first grade to help out with family chores. I do not remember having books in my household or ever being read aloud to; it wasn’t until high school that I sought out literature to read. I do not remember being supported in our educational endeavors, although I do remember one occasion in which my mother had my sister and me promise that we would do some type of training after high school in hopes that we would find good employment. Mainly, I remember being told to make good grades as not to embarrass my father. My father was very harsh, abrupt, and unpredictable. I remember how my father would bring my report card to his extended family get-togethers and brag about my “A's” to his siblings. I
followed the rules, and became a very good rule follower while mastering the art of invisibility; meaning I learned to be quiet and not to be seen.

I have deliberately chosen a much different home environment for my family and me. I want my children to be able to talk and interact with me, thus, creating a dialogue-rich home. I want them to explore and question the world around them, in hopes that this kind of interaction will provide them many educational advantages. I feel education is one of the main reasons that I was able to change my lifestyle and consequently, place a high value on the education of my children.

My educational and professional background has led me to my current research interests. I have a Bachelor’s degree in science education and have taught science in both formal and informal environments. I have a Master’s degree in Library Information Studies and have been employed as a children’s librarian. I use the tools of information literacy to drive the culture in our home and highlight the importance of education and learning. This has been done by filling our home with books, taking trips to the public library, purchasing books, reading daily to the children, and modeling reading to our children.

Data Collection

This research is supported by the Institutional Review Board at the University of Missouri, St. Louis, see Appendix A. Throughout the inquiry investigation period of three years (1,096 days), multiple sources of data were collected, including documents and records, interviews, observational notes, physical artifacts, photographs and videos. Throughout the entire three years, I was potentially present to document the daily science occurrences in our home. The tools used for data collection included:
field notes, which were either kept in a composition notebook or typed in Word documents on my laptop computer;

- family journals, which were created in spiral notebooks and journal books;
- audio, which were recorded on a small handheld audio recording device;
- video recording, which was recorded on the family’s point and shoot camera; and
- photographs, taken with the family’s point and shoot camera.

All data collected was stored in the researcher’s home, (Creswell, 1998).

The aforementioned methods of data were collected in and out of the home, various informal centers, and a catch all label of “other,” see Table 3.1, Data Collection Tools and Types. The incidents occurring in our home included our yard and surrounding areas, whereas informal centers included museums, nature centers, and libraries, and the “other” category, included traveling, nature walks, scouting events and other venues outside of the home and informal institutions. Since the research did occur in the lives of my family with many interactions over the duration of the three year study, the opportunities for data collection have been enormous and occurred at various times throughout our daily lives and social activities. Being an insider researcher allowed me to be present to document many incidents over time that may have been missed with an outsider researcher’s limited access to an individual’s home.

My field notes were written when the children were not around, this mainly occurred after they were asleep for the night. I would sit down to consider the science occurrence from the day to write and reflect on the incidents to the best of my memory. I felt this would be a lesser intrusive approach, as I did not want my children to feel that I was researching their every move, conversation, and books we read. I wanted our
interactions in science and exploration to be as natural as possible, participating in events we would have selected whether or not I was gathering research for this dissertation project.

Family journals were created by all family members during our travels away from our home in St. Louis. These included traveling to Hilton Head Island, South Carolina, Atlanta, Georgia, and the Smokey Mountains area of North Carolina. Each family would devote time to the family journal, by means of writing, drawing, and illustrating events during our travel explorations.

Audio recordings were executed with a small handheld digital voice recorder, an Olympus VN-5200PC, during storybook read alouds. Although I began recording all science read alouds events, this data collection method become somewhat obsolete, as I preferred to write field notes and reflections about our daily events. Another data collection tool, which was sparsely used, included video recording. I used the family’s point and shoot camera, a Pentax Optio W90, on the video recording setting to record the activity. I recorded two episodes that I felt were self-initiated inquiry.

Photography was a huge part of our daily happenings, therefore having a camera present seemed to be a natural event. Denny and I seemed to snap photos on a daily basis, while the children also had partaken with cameras of their own. For our photographs, I used the Pentax Optio W90, whereas the children occasionally took photos on their handheld gaming devices, Nintendo DSI. Since we have so many photos as part of our family collection, I sorted and categorized numerous photos stored on discs and our family computer and tagged ones around science and literacy. I have tagged 336 photos
that were taken in our home, informal centers and other places all related to our science and literacy explorations.

Lastly, the collection of artifacts included art work, stories written, collages, and the like. All artifacts were created in our home. Many of these artifacts were co-created between family members, while occasionally the children created artifacts on their own. After displaying the artifacts on our refrigerator for an undetermined amount of time, I collected each artifact and placed inside a plastic three-ring binder for safe keeping.

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<td><strong>Data Collection Tools and Types</strong></td>
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**Data Analysis**

Ethnographies rely greatly upon up close, personal experience, where participation rather than merely observation is a key process (Merriam, 2009). For this research project, I was continually a participant in our daily science activities, as well as the observer collecting and analyzing data along the way. During the day, I would participate as any member of the family. After putting the children to bed for the night, I would often reflect on the daily events by writing my field notes in a journal.

The guiding question, “How does my family foster science learning,” was used to inform all of my data collection and analysis. With multiple data sources (see Table 3.1) collected over the three year period (from April 16, 2009 through April 16, 2012), data analysis began at the onset of the project with continual analysis throughout the study. Analyzing and coding of field notes, audiotapes, transcripts, and photographs for emerging themes should take place simultaneously throughout the study (Merriam, 2009, Stake, 2005). With all ethnographic case studies, the identification of themes was essential (Creswell, 1998).

Data collected was condensed to provide the rich, thick description (Creswell, 1998; Geertz, 1973; Merriam, 2009; Stake, 2005; Wolcott, 1988) of my family’s science interactions. This rich, thick description provides the basis for answering the guiding question. Open coding for emergent themes (Creswell, 1998; Merrian, 1998, 2009; Stake, 2005) was utilized throughout the project to make sense of the variety of interactions that occurred within the case study, see Appendix C, Coding Example.

With open coding being an ongoing process, collecting data became streamlined over the course of the project. This coding revealed three themes that were essential to
this ethnographic case study. These themes included the use of science literature in our home, self-initiated science learning, and science communication. As the research project progressed over the three years, I began to focus my data collection and analysis around those three themes. The three subsequent chapters highlight the findings for each of these themes.

**Being an Insider Researcher/Trustworthiness**

Insider research, used to describe projects when the researcher has a direct connection in the research setting (Robson, 2002), has many advantages. Since the researcher is already familiar with the research setting, they normally appreciate the intricacies of the field leading to easier selection of the sample, possibly collecting richer data than the outsider, and may take advantage of their prior knowledge to pursue the research goals (Oliver, 2010). With all the familiarity with the research project, concern may arise as the researcher may take observations for granted and possibly overlook aspects of the data (Oliver, 2010), while ensuring trustworthiness (Lincoln & Guba, 1985). In order to build trustworthiness throughout the study, credibility must be established with all participants, suggesting data, descriptions, and analysis "rings true" (Erlandson, Harris, Skipper, & Allen, 1993) for each member. As I am involved firsthand in the research study, I have taken precautions to assure trustworthiness with my family. Since the very early notions of this type of research study, I involved my family in the decision making. Each family member was asked to participate in the study, and I frequently asked them their thought on the data and analysis. Therefore, my interpretation of the findings have included explanations from the researcher's experiences, from within the body of scholarly research (Creswell, 1998), and member checking (Merriam, 1998).
Validity

Merriam (1998) suggests six basic strategies to augment validity; these include triangulation, member checks, long-term observation, peer examination, participatory or collaborative modes of research, and disclosing the researcher’s biases. I have used each of the six strategies for validity throughout the investigation period and continued during the analysis and writing stages.

For triangulation, I have interpreted multiple sources of data collected throughout the duration of the study to provide a “holistic understanding” (Stake, 2005; Yin, 1989). I have analyzed my field notes, artifacts, family journals, and photographs throughout the duration of the research project. Member checking continually occurred with my family members by discussing if the results are plausible, while long-term observation has been met by studying my family members over three years. I was able to meet the requirements for peer examination by asking fellow colleagues, professors, and dissertation committee members to comment on findings as they emerged. These individuals have been present throughout this study to guide and push my study along. A participatory mode of research was achieved as I have involved my family in the discussion and decision making of this study focusing on our daily lives. Lastly, as the researcher, I have disclosed my assumptions, background, views, and other biases throughout this study.

Reliability

Reliability suggests that the research study findings can be replicated, which seems to be a misfit within the social sciences approach to human behavior (Merriam, 1998). Lincoln & Guba (1985) suggest determining the “dependability” or “consistency”
of the data and results. Hence, not for the research study to be replicated and obtain the same results, but to evaluate the data and results of the study at hand, making sure they are consistent. In this denotation, Merriam (1998) highlights three techniques to meet reliability; these include the investigator’s position, triangulation, and audit trail. First of all, in the investigator’s position, I have explained the assumptions and theory behind the study and the context in which the data was collected. As for the validity, triangulation has been met by collecting multiple sources of data and coding the data during the analysis. Lastly, my audit trail included mainly field journals that I have used throughout the duration of the study. With the data collected, I coded for emerging themes in our daily science encounters using research from the field.

**Ethics**

Research studies of this type can be a delicate matter, mainly in the ethics of data collection, analysis, and dissemination of the findings. With that being kept in mind, I have maintained a professional approach in handling the data and findings of my family. First of all, the IRB approval was given from the University of Missouri, St. Louis. Then, each family member gave their informed consent. For the children, my advisor, Dr. E. Wendy Saul, collected their informed consent. This was upon the University’s specification to ensure the children were willing participants in the research project. Data was collected and discussed with the participants, which provided the participants the opportunity to eliminate any information they found embarrassing and/or private. Lastly, results have been disseminated by portraying the depiction of my family’s daily science encounters with my analysis being a filter.
Limitations

With the time consuming nature of this ethnographic case study, many researchers and educators may not find the time necessary to read and apply the information to their needs and practice (Merriam, 1998). With one family participating in the study, it will be difficult to generalize the study to large populations. Lastly, with one researcher involved in the study for data collection, analysis, and interpretation, this may limit the findings.

Summary

Historically, White (1954) and Bissex (1980) went against the grain to study the significance of early literacy in their homes. In order to determine the learning potential of involving young people with science, I have developed and implemented a research study which followed the daily science interactions of my family. This study provides clarity into my family’s daily science learning which may be essential in the understanding and implementation of science in schools and society; and ultimately addressing science literacy. This study provides a rich description of how literacy practices can be used to support science learning in the hopes that parents, childcare providers, and educators will come to recognize and support the use of science learning in the daily happenings of young children or at the very least be aware of the types of resources to which we are exposing young children. The findings of the case study may influence practice and future research.
Chapter Four: The Eye of the Squid: Science Literature in Our Home

I read to my children for the educational benefits and for the exposure to high quality literature, all in hopes they will build upon these experiences and have advantages when it comes to their formal schooling needs and success in life. People read for different reasons. In an interview with my husband, he stated his main reason for reading to children, was to interact and bond with them; mainly a loving, sharing, caring experience. In his book, Reading Doesn’t Matter Anymore..., David Booth states “we [families] shared stories to be a part of life together” (2006, p. 17). Personally, my main focus is on educational opportunities, although I cannot deny the satisfaction one gains by spending time engaging with books with your children.

As with other leading emergent literacy experts (Teale & Sulzby, 1986) I feel early exposure to literacy is essential to the eventual learning of literacy. Our children have been immersed in storytelling and read alouds before birth. For us, we would utilize books and model the use of books throughout the day, but our nightly rituals of selecting and reading books were something we each looked forward to. Books can be an escape, a special place, memory, or there to help a young child when needed. Books can provide guidance, learning, and exposure. As young children develop and explore the world around them, science books can provide some clarity and understanding as they are developing their understanding. The Commission on Behavioral and Social Sciences and Education (CBASSE) recognizes the importance of surrounding very young children with written language and the functions of reading in society. They assert that a “child’s reading-related development is interwoven and continuous with development that will
lead to expertise in other spheres of life” (NRC, 1998). Throughout this chapter, I will illustrate the role literature plays in our daily life through highlighting the stories we shared and how meaning making and different connections were made.

In our home, we had slightly over 300 children’s books; consisting of books we have purchased from local used book sales and thrift stores, book fairs, and/or received as gifts. Of those, half have science related themes, including fiction and non-fiction. We use other opportunities to interact with science books through our local library, nature centers, and, also, at my fingertips, was a collection of over 3,000 science books that I helped maintain as part of my graduate work. As I reviewed books for the science library, I would often read those books aloud to my children. Our personal collection and access to other book collections at informal institutions and at the science library enabled us to immerse ourselves and our children in a wide variety of science literature. In addition to books, we sought other print materials for our home. On a monthly basis, we received our state conservation department magazine which is free and frequently picked up other free magazines and pamphlets provided by the conservation department. The children each have a shelf of books in their own bedrooms, as well as shelves in our living room devoted to books, magazines, journals, and other materials. We have books stuffed in closets, under beds, and in toy boxes. I was determined to provide a home rich in literature. As parents, we modeled the importance of literature through reading for our own enjoyment, which included books, magazines, newspapers, and electronic readers, and I am sure my enrollment in a doctoral program has influenced the literacy happenings in our home.
While pregnant with Sean, I was finishing my coursework for a master’s in library science. During that program, I remember taking a class that stressed the importance of reading to children, beginning at birth. Since this course left a lasting impression on me; I knew I would read to my children, beginning in pregnancy and continue that tradition until they asked me to stop. Although my children are both in elementary school, I still read aloud to them and look forward to this tradition we have created. In the fall of 2011, I read *Charlotte’s Web* by E.B. White, aloud to my children; this happens to be the first chapter book that held both of their attention throughout the duration of the book. As I often planned to read one chapter per night, right before bedtime, they anxiously asked for additional chapters. Often, I continued reading until both children fell asleep, then reread that chapter the following night. Reading *Charlotte’s Web*, with its many scientific themes, added to our science and nature loving family adventures and activities, from spiders to pigs. Currently, when we see a spider, the children make references to Charlotte.

When the children were younger, book selection was easy for us. As parents we chose books that we loved or wanted to read to our children. Once the children were old enough, book selection became quite different. Sean, being a nonfiction, dinosaur loving boy, would often choose books that revolved around science themes, including books that focused on the world around us which reflected his developing interests in the natural world. Keara, on the other hand, did not gravitate towards science books or really any nonfiction books. Keara selected books around princess themes, usually with much glitter and sparkle, which also reflected the clothing she chose to wear.
By looking at the photograph below, see Figure 4.1, you can see Keara’s personality shining through with her clothing selection. She is wearing a pink skirt, sparkly necklace, and ruffle socks, while the look on her face declares she is confident with herself. David Booth (2007) described his literature relationship with his son as a place of both convergence and divergence, stating

He has helped me to accept the books that matter to him and to me; sometimes our dreams converge, but when they don’t, I leave space on the shelves for all of our choices, arranged in random order, like our experiences with the books that hold on to us forever (p.74).

At the time this picture was taken, we were preparing to go on a hike. From my

![Figure 4.1 Keara’s ready to Hike](image-url)
perspective, I didn’t think Keara was wearing the typical hiking outfit, and she didn’t mirror Sean and me in our hiking gear. I asked Keara if she wanted to wear the fancy outfit to the nature center and hiking or would she like to change into something for the outdoors. Keara did not change her outfit. By negotiating books and clothing with Keara, she has helped me to appreciate her interest and identity, while welcoming their importance in her life, even if I don't always agree with her choices.

Textual connections are essential to literacy development and comprehension. According to Keene and Zimmermann (1997), readers make three types of connections before, during, and after reading; they include text-to-self connections, text-to-text connections, and text-to-world connections. With a little modeling and continual use of books, children will make these connections. Steve Jenkin’s book, Actual Size, see Figure 4.2, portrays organisms and body parts in their actual size, some small and others very large are illustrated. The pages contain illustrations of the organism or body part, along with a one sentence description along with the measurement.

Figure 4.2. Actual Size by Steve Jenkins
While walking through a thrift store with Keara, I noticed the book of *Actual Size* on the shelf in the children’s section. The book being in perfect condition, I immediately grabbed the book and knew I would want to add it to our home library collection. I quickly showed the book cover to Keara, while not hiding my enthusiasm. Keara pushed the book aside, then selected a princess story on a nearby shelf. After trying to show the book to her again and her once again ignoring the book, I said I would buy the book. Keara tried to persuade me not to buy it, stating, "I don't like it." I simply replied that I did. We later spent 15 meticulous minutes over the jewelry cases in hopes that Keara would find a treasure. That day, she did not find a treasure. I purchased the book and once we were at our home, I placed it on one of the children’s book shelves in the living room. The book sat almost one week on our shelves and no one picked it up or mentioned the book. The next week, on a Thursday evening after our evening rituals of homework, outside play, eating dinner, and bathing, we entered the living room to select books for the evening. I have Sean and Keara select one book each. I walked over to the shelves and noticed the book, *Actual Size*, and grabbed it. Keara selected a princess book for me to read. I say sure, but we are reading mine first. We all jump on the sofa, and relax with books in hand. First, I put my hand on the cover, modeling the size differences of my hand to the gorilla (see Figure 4.2), but say nothing and begin reading the book. Turning to the first page with the atlas moth, see Figure 4.3, we begin making comments.
Glenda: Wow that is huge. I bet it could pass for a bird.

Sean: Like some of the birds in our yard. I would like to see one of those moths.

Glenda: [I read the description, and then turn the page].

Sean: [immediately, Sean places his head on top of the page with the large squid eye, see Figure 4.4] He laughs, then says, “This eye is as big as a human head.”
Glenda: Right, awesome! The giant squid’s eye is larger than a human head.

Awesome. I wonder how big the body is?

We continue reading the book. Noting the Goliath Birdeater Tarantula’s body (only the body, no legs, see Figure 4.5) is about the same size as a hand. When we get to the page with the gorilla hand (same illustration found on the book cover, see Figure 4.2) Keara immediately puts her hand on top of the gorilla’s hand. (Keara did this faster than Sean and me). We then compare the size differences of each of our hands to the gorilla (Field notes, 10/1/2010).

A book can be quite entertaining, engaging, and interactive, yet very educational at the same time. This new book was added to our library collection and read many times thereafter. Immediately, Sean and Keara were able to build text to self connections throughout the entire first reading of this book, with little prompting on my part. I simply placed my hand on top of the gorilla’s hand, and didn’t say or elaborate on anything.
Sean was able to immediately look at the squid’s eye on the page and make a reference to his body, stating, "The squid’s eye is as big as a human head". These are the textual connections that aid in literacy comprehension, as well as science learning. This science information book did provide the text-self connections that are essential to comprehension skills and learning science process skills. These connections will be important in learning science and exploring the world as they continue to grow and develop. Making observations and connections to the natural world are central to children’s learning in science (Dyasi & Dyasi, 2004; Harlen, 2001; Worth & Grollman, 2003). Observations, one of the major components of the science process skills and the nature of science, aid in the progression towards science literacy.

Other incidents of making textual connections include the book, Hooway for Wodney Wat by Helen Lester; see Figure 4.6, a fictional book about a rat named Rodney

Figure 4.6 Hooway for Wodney Wat by Helen Lester
that cannot pronounce the letter ‘r’, and other rodents that attend P.S. 142 Elementary School for Rodents. This book has been a staple in our collection and many read alouds since Sean was an infant. Denny is a fascinating story book reader. Even as an adult, it is fascinating to watch Denny read this book to the children. A good reading of a book can make the story interesting, but a great reading of a book can make the story come to life. Denny does just that for our children; his enthusiasm and animations during read alouds are contagious. The readings are engaging and frequently mimicked by the children.

Although this book, *Hooway for Wodney Wat,* does not reflect a science theme, mainly focusing upon bullies and confidence, we have been able to obtain science learning connections from the exposure of this book. In the fall of 2009, Keara was three years old and Sean was seven. The three of us had visited a neighboring city park, about 5 miles from our home for exploring nature and free play at the playground. During the nature walk, we collected autumn leaves that were full of vibrant colors. Upon returning home, I placed the leaves on our kitchen table along with various fall themed books, all in hopes of making leaf collages in the next few days. Often, I used the kitchen table as a place to keep our items from our various adventures, books, and craft supplies. A couple days later, while in the kitchen with Keara, she grabbed the leaves, held them up to her face and yelled “wake up, wake up,” and then proceeded to laugh hysterically.
Here, this illustration, show the rodents playing Simon Says, see Figure 4.7. Rodney, being the leader, tells his classmates to “wake the leaves.” Since Rodney cannot pronounce his “r’s” correctly, Camilia Capybara (the large rodent in the right hand corner, also the bully of the class) begins to pick up the leaves and yells at the leaves to wake up, while the others students, aware of Rodney’s speech, begin to rake the leaves.

While playing a board game with the family and some extended family members over the holiday season 2011, once again, I was reminded how literature has impacted our exposure, experiences, and learning. Playing the board game, Name Five®, which is a game that states a category and your team must successfully name five items that fall into the category given. When Keara’s team was given the category “Types of Rodents,” I prompted her with “Hmmm, Wodney Wat”.

Denny: [yells] capybara.

Keara: Hmm, hamster! Guinea pig! Mouse!

This prompt was enough for Keara to start calling out the types of rodents found in the fictional work, Hooway for Wodney Wat (observations from 12/23/2011). Keara has mimicked the content in the book to her own life, a world-to-text connection (Keene &
Zimmerman, 2007). This world-to-text connection is illustrated by trying to “wake the leaves,” to successfully naming the different kinds of rodents found in this book during participation of a board game. Books become a part of our life as play and make a lasting impression as a memory aid. Reading a book can change your life forever, while providing foundational knowledge. I doubt Keara would have been able to successfully name the types of rodents if we hadn’t read *Howay for Wodney Wat*.

We have loved and used our fiction books in many ways. Sean found the inspiration he needed from a fictional children’s science book. Sean and Denny, being actively involved in the Boy Scouts of America, went to a rock climbing event with Sean’s den. Sean was the only member of his den to successfully make it to the top of the wall and ring a bell. As Denny was preparing Sean for bed, they had the following conversation:

Denny: [to Sean] I am so proud of you for climbing that wall.

Sean: I didn’t think I would make it to the top.

Denny: I knew you would.

Sean: I imagined I was climbing the cliff to save the dog in *Cliff Hanger* [By Jean Craighead George]. He [the dog in the book] was on Monkey Ledge and I was saving him.
The book, *Cliff Hanger*, see Figure 4.8, is a rock-climbing, outdoor adventure, in which the main character, a young boy named Axel, must save his dog. The dog is stranded on a cliff during an approaching thunderstorm. Axel does climb the cliff and safely reaches his beloved pet; therefore, overcoming fear just as Sean successfully climbed the rock wall.

![Figure 4.8 Cliff Hanger by Jean Craighead George](image)

As parents, we support our children’s interests and provide the encouragement needed during new experiences. With this support and encouragement, we celebrate their achievements. This was Sean’s first experience with a rock climbing wall. In this case, literature provided Sean with the support and inspiration he needed to successfully climb to the top of the rock wall during this Cub Scouting event.

**Nonfiction**

Fiction has played a dramatic role in our life, but there are times to share nonfiction with young children. In graduate school, while reading Nell K. Duke’s research study, “3.6 Minutes per Day: The Scarcity of Informational Texts in First Grade” (2000), I became quite alarmed that nonfiction books were not being used by
young children and in schools. I knew my son preferred nonfiction over fiction, and that other researchers say boys prefer nonfiction books (Booth, 2006). I would often question why parents, school, and daycares might under utilize this resource and its lack of early exposure to young children, when clearly some children do migrate to nonfiction literature. Furthermore, nonfiction has such a dominant role in schooling and our adult life. As Nell Duke (2004) says, “Success in schooling, the workplace, and society depends on our ability to comprehend this material [informational sources]” (p.40).

Throughout Sean’s life, he has selected nonfiction over fiction books. As his interests evolved and changed, his book selection also changed. When his main interest was dinosaurs, we selected many small nonfiction series books about dinosaurs from the public library to books from our home library collection, which included books such as *Jurassic Shark* written by Deborah Diffily and paintings by Karen Carr. We read *Jurassic Shark* numerous times, which eventually began to crinkle the corners of his favorite pages. After “smuggling” an anole, a small and common lizard found in the southeastern United States, home from a trip to southern Florida, when Sean was 4 years old, Sean had an educational exploration for the next three years through the observations of this reptile until its death occurred. Initially, I didn’t want to remove nature from its original setting and still do not condone removing nature from its original habitat, but felt defeated and exhausted after spending the week in Florida with a four year old. Upon returning home, we ventured to the local pet store to buy the needed equipment to keep an anole alive in our climate, which is much different from the Southern Florida climate. This mishap quickly became quite the learning adventure for our family, from daily observations of a
reptile eating live crickets to the time of the great lizard escape. In the great lizard escape, the anole lost its tail, which began our observations of tail regeneration.

Sean’s interest in reptiles, led to a small purchase of *My First Pocket Guide, Reptiles and Amphibians* (1996), see Figure 4.9, from the clearance section from a large bookstore.

We only paid a couple of dollars for this book. Sean carried this book around until the corners and edges where curled up, which is noticeable in the photo in the lower right hand corner. Being that Sean carried this book everywhere, he brought it for a day trip to visit some friends (about two hours from our home). At this time, Sean loved to visit these family friends because he had a playmate of the same age, and like Sean, she was a big nature lover. While on one of their outdoor adventures, Sean and this girl “fought” over the book in the backyard while trying to find reptiles to identify. We later purchased an identical book and gave it to Sean's friend as a gift.
Blending of Nonfiction and Fiction

I wanted to read science books to Keara, but she having her own opinion, always went for the “girly” books. While engaging with Keara, I would not refer to these books as “girly,” even though they were not the types of books I wanted to promote, much less read. These books mainly included princess themed books. I didn’t interfere with her choices, but would make deals with her. She would select a book for read alouds and then I would select a book to read. My selections would be around science and mostly informational, or at times trying to select something that we might be able to make a connection to, or promote a science learning activity.

The first time I have documented that Keara selected a science book, she was four years old. It was late spring 2010, with baseball season in full swing and planting season had begun. We had many sunflower seeds around the house for two reasons. Denny, Sean, and Keara had been eating the seeds while they were watching baseball games and I had purchased a packet of sunflower seeds to plant in our yard. I had placed the packet of seeds on our kitchen table (the “catch all”) while waiting for a day to put them in the ground. Keara, looking through books on the children’s shelf, picked up the book Sunflower House by Eve Bunting, see Figure 4.10. As she was looking at the book, she noticed a page with sunflower seeds. We began talking and reading the book as Keara was interested to see the seeds that she had been eating with her Dad and Sean.

Keara: look at all the seeds on the ground.

Glenda: Hmmm? What are you referring to?
Keara: [shows me the book, *Sunflower House*, and points to a sunflower seed] we eat those.

![Sunflower House by Eve Bunting](image)

**Figure 4.10 Sunflower House by Eve Bunting**

Glenda: Yes, you do, with Daddy and Sean, but we can also put those in the ground. [Referring to page 4 of the book]. Look at the seed, they are just like the ones that you eat, but here the seed is in the ground and has a root and shoot forming.

Glenda: [reading and turning the pages] Look the boy is measuring the plants as they grow.

Keara: Can we plant some of our seeds?

Glenda: Yes, we can (Field Notes, 05/17/2010).

That day, this book selection process was made possible by providing numerous books in our home, having sunflower seeds around the home for eating and planting activities, and modeling the use of books for resources. I was shocked and very pleased that Keara had found that book. Something as simple as eating sunflower seeds grabbed her interest and kept her involved in a science book.
Another time, I was able to grab and hold Keara’s attention to nonfiction, due to making references to a fiction story that she loved. Our kitchen table, always being used for our artifacts and books, provided us with another opportunity for learning. When we would receive magazines and other information, I would leave these on the table, in hopes they might grab the family’s attention from time to time. Upon receiving the September 2009 issue of the Missouri Conservationist, see Figure 4.11, with a big

Figure 4.11 Monarch Butterfly, Missouri Conservationist

photograph of a monarch butterfly on the cover, I placed this on our kitchen table. This magazine, along with two sports newspapers (USA Today Sports News), three books (John Dewey, Field Guide for Trees, and Powerful Magic), a current Lego magazine, and
a Midwest Living with pumpkins on the cover were on the table. Keara and I were in the kitchen, when she noticed the large butterfly photo.

Keara: [grabs the Missouri Conservationist] Wow, I want to see this one with the big butterfly. [She observes the cover briefly and begins to turn the pages].

Glenda: [turning to page 14] Look at this one. [Close-up photo of a caterpillar, see Figure 4.12].

Keara: Oh, oh, that is yucky [and turns away from the photo].

Glenda: Oh, wait, that is the very hungry caterpillar.

Keara: Oh. [Turning back to the magazine].

Figure 4.12 Close up of Caterpillar
Glenda: Look, here he is hanging [turns page, see Figure 4.13] upside down and forming a chrysalis [points to the photos on the following page, and then turns the page].

Figure 4.13 Chrysalis Formation

Glenda: Look at the chrysalis now…and now he turns into a… [turns page]…a beautiful… [I am pointing to the photos across the top of page with the butterfly emerging from the chrysalis].

Keara: BUTTERFLY! (See Figure 4.14)
Keara: Let me look at that [she observes the photos briefly and begins turning pages in the magazine].

After showing Keara the photo of the caterpillar, she did not want to look any further at the photos in the magazine. She felt the image of the caterpillar was “gross.”

Upon my prompting and connecting the text to another text, *The Very Hungry Caterpillar* by Eric Carle, which she was very fond of, I was able to capture her interest in this informational reading selection. We did read and observe the different stages of the life of the butterfly. Because of this incident, she may be able to build upon this knowledge.

**Summary**

What can reading do for you? In our home, reading played a huge role in our life, from providing context for learning and activities to providing meaning to the world around us. We were able to make books and reading a natural part of our life. It was
never a chore. We enjoyed reading and books and all that they can offer. In times when I felt a little cringe reading a princess book, I never forced my children to read only my book selections. In exchange, we made compromises with books while using their passions to fuel their explorations. Here, both fiction and nonfiction played important roles in our happenings. Yet, reading is not enough. You must combine children’s questions as well as your own to help children make connections and gain a richer understanding of the text and the world around them.
Chapter Five: Making Rock Candy: A Study in Self Initiative

Towards the end of the three year study, Keara referred to me as “mom knows a lot.” I asked her what exactly she meant by that. She said, “Well, you know a lot about science.” Although Keara meant very well by this comment, I was a little hurt by it as I have purposefully not answered all of my children’s questions surrounding their natural curiosities about the world around us. By purposefully not answering my children’s questions, I have encouraged them to pursue inquiry investigations in hopes they would begin to learn different ways to answer their own questions. With that being said, I found Keara’s comment a little strange, as I believe I am not a “science know it all,” as I had supported inquiry investigations and withheld my answers and knowledge in numerous situations as we explored the world around us. I did this all in hopes that Sean and Keara would eventually become science literate individuals; and they would “know it all,” or simply know how to find the answers to their questions of their natural curiosities.

Early in my professional education career, as I was teaching in the public schools, I frequently used hands-on methods of instruction, along with more traditional approaches to teaching science content. My interest in inquiry began to develop while working at the Missouri Botanical Garden and through my participation in a certification program at the Center for Informal Learning and Schools (CILS), at the Exploratorium, in San Francisco, California. This certification program began in the fall of 2004 and concluded in 2009, with many workshops and conferences held at the Exploratorium devoted to inquiry and to both informal and formal science education. Throughout my involvement in this certification program, I read various inquiry publications from leaders in the field and then attended workshops and conferences with those same authors and
other science educators such as myself. This really was a fabulous opportunity to learn with and from the leaders in the inquiry field.

Due to my background with the CILS program, I follow the inquiry method developed by the Exploratorium, which describes inquiry as a continuous cycle in which learners move in and out of three different phases for the inquiry process. These phases include Inquiry Starter, Focused Investigation, and Sharing Understanding. The first phase, Inquiry Starter, begins with observations of interesting materials and phenomena that ignites the learner’s curiosity and initiates questions. The educator, or more experienced person, will guide this initial phase of question development by helping the learner develop their questions around their observations of materials and phenomena. Once curiosity is sparked and questions are asked, this leads to the next phase, Focused Investigation. Here, learners will plan and carry out investigations based on their questions. Throughout this phase, learners use the science process skills, “play” with the materials, devise plans for investigations, and perform the investigations. Finally, learners will enter the last phase of inquiry, which is Sharing Understanding. Communicating their results and findings with others in order to further their understanding of a scientific concept is an essential part of the Sharing Understanding phase. The process is not linear, meaning the students will enter in and out of the phases as they are exploring scientific materials and phenomena to aid in their understanding (Institute for Inquiry, 
http://www.exploratorium.edu/ifi, 2/01/2012).

My involvement in the CILS program convinced me of the benefits of learning by the inquiry method; therefore I support the inquiry methods and believed if I used this approach with my own children, they would develop critical thinking and problem
solving skills pushing them along the path of becoming science literate individuals. As we explored the world around us, in such places as our backyard, parks, nature centers, museums, and family outings, I modeled asking questions based on my observations, organized investigations by using reference materials and experimentation, and shared our findings and knowledge with others. In order to model inquiry learning for my children, I do not provide answers to all of their questions from our observations of the world around us. When prompted with a question, I would state, “Good question. How could we find out more?” Or, simply, “Awesome question, maybe we could find an answer in a book or by investigating.” In turn, I frequently modeled questioning when we were on our outings and adventures. To find answers to our questions, we often used books, magazines, and the Internet. At other times, we would set up investigations usually upon my prompting and doing. By doing this, I felt I wasn’t the “science know it all,” as I was modeling science inquiry for the children, as inquiry is an essential skill that leads to critical thinking and problem solving and closely mimics the enterprise of doing real science (Dyasi, n.d.).

In this chapter, I am focused on the times my children displayed self-initiated inquiry, learning to find answers to their own questions. Hence, the children did not have my questions or prompting; they noticed phenomena, asked the questions, sought out answers, and communicated their findings with others. I was a bystander, simply aiding and providing help when they asked or it seemed necessary. I feel self-initiated learning is the path to lifelong learning. I offered support and promoted this approach to learning in hopes my children would develop a natural curiosity about the world around them, while learning how to find answers on their own. The illustrations used in this chapter
reflect my children fulfilling the role of the “science know it all”; by this I mean they are using inquiry to find answers to their own questions.

**Rock Candy: A Study in Self-Initiative**

About ten months after I began collecting data on my family science adventures, I rushed home one afternoon to meet Sean as he was getting off the bus (Field Notes, 02/16/2010, Time: 3:20 p.m.). Since we would have a little over one hour before rushing to get Keara from our child care provider, I turned on the television to our local PBS station, which was airing a show about science. The host of the show, an energetic girl, is in the home of a young boy, who is probably in the 5th grade. The boy leads the host and subsequently, the audience, through the process of making rock candy. Upon finishing, the boy shows his own crystal collection. As the host of the show and the young boy allow approximately one week for the rock candy to form, they take an excursion to the American Museum of Natural History. During this visit to the museum, they visit the enormous crystal collection present. The show concludes with the two returning to the boy’s home to look at the rock candy experiment and providing the instructions for making your own rock candy. According to the National Research Council of the National Academies (2010), learning through media requires different design strategies. Since the challenge is to find alternative approaches to make science come alive, media highlights what science activities look like, a name they have given as “interactivity”. They describe the media’s goal as “telling a story about science inquiry; the possibility for interactivity lies in reproducing the process at home, with support potentially from the Internet” (NRC, 2010, p.56).
Upon seeing the instructions for making rock candy air on the PBS show, Sean immediately wants to make rock candy. I, on the other hand, was not very enthusiastic about the idea. I really wanted to sit and relax before running out to get Keara and then starting the evening rituals of dinner, homework, reading, and baths. Consequently, I try to divert Sean about making rock candy, by saying I didn’t remember the instructions. The following is our conversation at the conclusion of the television show.

Sean: I want to make rock candy.

Glenda: Do you remember the recipe?

Sean: No.

Glenda: I don’t either.

Sean: I will go look it up.

Glenda: Where? What?

Sean: On the computer.

Glenda: Okay. The computer is turned off, use the power button on the tower and wait for it to start.

Sean: [leaves living room and walks down the stairs to basement computer room.]

Glenda: [walks into kitchen and begins unloading the dishwasher. About 3 minutes later…]

Sean: Mom, Mom…

Glenda: [walks downstairs to computer room]

Sean: [as Glenda walks into room, Sean points to computer] there it is.

Glenda: What?
Sean: The recipe. There is the recipe for rock candy.

Glenda: [looks at computer screen and sees some instructions for making rock candy]. Yes, there it is. What does it say?

Sean: [reads the list, 2 cups water, 4 cups sugar, warm water, glass jar, pencil and string]

Glenda: Okay, let’s go make it. (Field Notes, 02/16/2010).

Although I wasn’t keen on the idea of setting up the experiment, with Sean’s display of self-initiated learning that had just occurred, there was no way that I would say no. That day, Sean turned on the computer, logged on under his name, and opened Internet Explorer. At this time, Sean’s homepages automatically loaded two websites; one tab was Lego while the other was PBS kids. After his homepages had loaded, Sean clicked on the web address box and selected Google from the list. He went to the Google® homepage, and typed “how to make rock candy” in the search box. When the page loaded, Sean clicked on the first entry that was listed as “rock candy,” scrolled down, and found the recipe. (http://candy.about.com/od/hardcandyrecipes/r/rock_candy.htm, 02/16/2010).

We walked upstairs to the kitchen and gathered the needed supplies and began performing the activity. I aided Sean as he needed and suggested, but mainly followed his lead in setting up the experiment. We added the sugar and warm water to the jar. Sean stirred the mixture until sugar was dissolved. We then took the string and tied around the pencil. Sean measured the string with the height of the jar and cut off the extra. Sean placed the pencil across the top and let the string hang down into the mixture. We put the jar on the kitchen counter. At this time we only set up one jar.
Glenda: We can make observations all week. You know, Sean, this would make a great science fair project. We could change one thing and watch what would happen to each jar that we set up.

Sean: Awesome. We could change the size of the jar or the water or sugar. I can see which one makes the biggest crystal.

Glenda: Good ideas. Let’s see what happens. (Field Notes, 02/16/2010, Time: 3:20 p.m).

That day, Sean displayed self-initiated inquiry learning by watching a science oriented show on television. He used technology as a means of inquiry to pursue his inspiration of performing the experiment on his own. Both, Dewey (1938, 1950) and Rogoff (1994) advise of the pitfalls of unguided discovery, instead recommending a more experienced person to guide learners. Rogoff (1994) recommends a “community of learners” model based on the assertion that “learning occurs as people participate in shared endeavors with others, with all playing active by asymmetrical roles” (p.209). Polman & Pea (2001) suggest that formal educators must find the balance between “structuring and guiding student activities in the classroom without taking away the student’s active role” (p.225).

This balance of talk between student and teacher, based upon Pea’s (1994) notion of transformative communication, supports students as active learners bringing extensive backgrounds and prior knowledge to learning. Transformative communication maintains “the necessary balance between student ownership and teacher ‘control,’ since both parties make crucial contributions” (Polman, et.al, 2001, 235). By parent and child negotiating activities and communication, Sean and I were able to successfully develop the rock candy experiment. Sean watched television, used technology as an aid in
learning, and acted as a scientist all in one short time period. Once the rock candy experiment was set up, we ran out the door, jumped into the car, and went to get Keara from childcare. Over the next couple of weeks we did observe the formation of a crystal.

Approximately four weeks after the initial rock candy incident, Sean used a rock candy experiment for his science fair project by changing the amount of sugar he would add to each jar. I remember talking to Denny regarding the set-up for the experiments as I was getting ready to leave for a week to attend a national conference on research for science teaching. I said to be sure to only change one variable for the experiment, like the amount of sugar for each jar could change, but nothing else (Field Notes, 03/18/2010). Upon returning from the conference, I observed five jars of rock candy lined along the kitchen sink. Denny commented they were making daily observations of any possible crystal formation, although Sean was extremely reluctant to write down any data in the printed journal which was supplied by the school. That year, Sean chose not to take his project to school to participate in the Science Fair. Sean stated, “Last year, I didn’t win, so I don’t want to do it.” (Field Notes, 03/25/2010).

A few days later, after Sean’s initial rock candy experiment, I found Keara in the bathroom, with a pink, plastic princess cup trying to put together a rock candy experiment of her own. Keara found the pink plastic cup in her bedroom, a piece of string, which was the same string we used for Sean’s rock candy experiments, and a pencil. She had filled the cup with water from the bathroom faucet, tied the string to the pencil, and then placed the string in the water, resting the pencil on the top of the cup. I asked Keara what she was doing, she stated, “making rock candy like Sean” (Field Notes, 02/15/2010). Although Keara’s science experiment was set-up correctly, she failed to add the essential
ingredient: sugar. Keara was not present during Sean’s initial design and set-up of the rock candy experiment; she did observe the experiment since it was placed by the kitchen sink. Initially, Keara was interested in the experiment by the kitchen sink and did not express interest later. I was quite surprised that I had found her designing a rock candy experiment on the bathroom floor. She did not put the experiment in the kitchen and did not show interest with the experiment after the initial set-up.

Keara, rarely finding an interest in science, sneaked into the bathroom to try her hand at experimenting with rock candy. True to her identity, Keara set up a science experiment using a pink cup with a princess logo. Keara’s inquiry may be somewhat limited due to her other interests, in regards to Sean’s expansive science interests, but she was able to mimic the inquiry methods that we are modeling in our home. Although Keara operates on her own schedule, when an idea interests her, she will utilize inquiry skills to aid in her exploration and play.

**Keara’s Exploration in Self-Initiated Inquiry**

Months later, at the age of four years, Keara had a first self initiated sustained curiosity and exploration; this was the first science inquiry I observed her initiating. Keara was taking water and a bowl into the bathroom, with Sean following with a soda in hand. As I entered the bathroom, they poured both water and soda into a small bowl. Keara said, “I want to put this [pointing to bowl] in the freezer.” We put the bowl in the freezer. About four hours later, Keara checked on the bowl and declared, “It is frozen.” Keara gathered three other small plastic bowls from the kitchen cabinet and placed all bowls on the kitchen floor. She began her investigation by pouring water in the containers, taking the container with the frozen mixture of water and soda and placing it
into different containers. She obtained a kitchen step stool and looked through the pantry and eventually removed packages of drink mixes and candy sprinkles. Later, she noticed that I was watching her; she looked up at me quizzically, as to say, “Can I continue?” As I nodded yes, Keara poured the powdered drink mixes in the water, added sugar sprinkles to the mix, and continued to explore for twenty minutes (Field Notes, 11/02/2010).

During Keara’s investigations, she would pour water on the ice, removing ice from the bowl, and moving the ice and water to various bowls. After adding the powdered drink mixes to the water, she commented on the various colors and how they were changing from one color to another.

Looking at the data from our science investigations in our home, Keara obviously operates on her own schedule. When an idea interests her, she does utilize the inquiry skills that we have been modeling for both children. This is shown during her sneaking into the bathroom to set up her own rock candy experiment and in the investigation of the ice, powdered drink mixes, and sprinkles of her own initiative. Although Keara may not engage in inquiry to the same extent as Sean, she has developed many of the skills that we have modeled for her. Keara obviously displayed her own curiosity and sought out to find an answer to her thoughts.

Gathering Science Information

At other times, both children would do various levels of research to put science information together. One summer, their childcare provider made information books with each of the children. Keara, once again following her interests, focused on fashion and princesses, although Sean put together a book on eagles, his favorite bird of choice. Another time, the neighborhood high school babysitter made collages with the two of
them during Sean’s spring break from school. As I am getting ready to leave for the day, Ellen, our neighborhood babysitter, is about to enter to stay with the children for the day.

Sean: I have a new favorite mammal, the platypus. I wish I had a toy platypus.

Glenda: Yeah, why?

Sean: It would be neat, I don’t have one.

Glenda: Right, you know, it would be cool to go to a zoo that had one. We would actually get to see it.

Sean: Yeah. Can I look for a platypus on the computer and print?

Glenda: Yes, you can print a couple of pictures.

Sean: How do you spell platypus?


[Ellen enters]

Sean: Can you write it down?

Glenda: Ellen knows how to spell it; she can help you while I am gone.

Sean: Please write it down.

Glenda: [writes down platypus then gathers backpack and goes to leave].

Sean: Bye. [Grabbing paper and running downstairs to computer room].

Later that day, I return home in the afternoon to observe Sean had created a collage of platypus pictures. He has printed many more than the two picture maximum that I had given him earlier that day, although I didn’t mind, as I thought it was something that had educational value. Later that same day, we discussed his collage and his thoughts about the platypus. Picking up the collage, I stated that was a lot of pictures he printed from the
computer. Sean, “Yeah, it’s a lot of pictures, but I really like them, they are my favorite. I really wish I could see them at the Zoo” (Field Notes, 03/17/2010).

**Technology Supported Self-Initiated Learning**

At other times, Sean’s displays of self-initiated learning were in ways that utilized his technology skills as a means of inquiry. At the time, Sean had a handheld gaming device that also had a camera which he frequently used to snap photos and edit them in various ways. Always, upon my surprise, I would see Sean grab the gaming device and would take pictures of things that interested him, such as the time he was taking pictures of Amazon River Dolphins from a show on PBS (Field Notes, 3/14/2010). Sean and I were watching television when the National Geographic Top 10 Photos of 2009 were portrayed. The tenth best photo was of the Amazon River Dolphin. This was the first time that Sean had been aware of this animal. He immediately jumped up and wanted to find his gaming device, then ran to his bedroom. Sean came back to the living room and stood in front of the TV, with device in hand, to take photos of the Amazon River Dolphins from the television screen. Sean was very impressed with this dolphin and commented on how interesting and cool they were. About two days later, (Field Notes, 3/16/2010), Sean discovered that the photos were missing from the gaming device.

Sean: Keara you deleted all the photos. ALL my Amazon River Dolphin photos. Now I don't have any. You are not allowed to do that. You can only play and mess up your photos, not mine. You are not to go into the other features. [Sean shows the device to Keara and illustrates what to do and how to do it.]

Note: Sean had about 400 photos saved in the game, many different photos. Sean has been taking photos of animals from other PBS shows and various outings.
Other times, Sean would use technology to seek out answers about the world around him. As I snapped the photo below, see Figure 5.1, I was flabbergasted to see Sean’s display of technology as applied to self-initiated inquiry of the natural world.

![Figure 5.1 Saint Louis Zoo, Insectarium, 2/20/2010](image)

While visiting our local zoo, we entered into the Insectarium and the small Butterfly House, Sean immediately begins taking photos of butterflies that surrounded us. After saving a few photos on his handheld gaming device, I observed Sean walk over to a Docent to obtain help in identifying the butterflies. In the photo above, Sean and the Docent are using his photos, taken on the gaming device, for comparison to the butterfly photos in the three-ring binder. That day, Sean was able to obtain the name and information of the butterflies he observed at the Insectarium, in which he completely self-initiated his science learning by his interest and connection to living things. Sean sought out the answers to his questions of recognizing and classifying organisms with the aid of technology.

**Summary**

When Keara characterizes me as knowing a lot, my reaction was to distance myself from the quality of “knowing,” as I wanted my children to view me as a co-
investigator of knowledge. As we explored the world around us, my aim was to model and share knowledge rather than to be a person that tells knowledge to others. I like to set the learning stage for my children, by verbalizing my observations and asking questions. I don’t intentionally say the answers or want to be the know it all, but the children are aware of my knowledge. Essentially, children do view adults or a more knowledgeable person as a “know it all,” but my aim was to model and create opportunities to build our knowledge together.

In this chapter, I have illustrated the ways that my children have engaged in self initiated science learning of their own free choice. Initially, I was quite surprised and shocked when Sean wanted to make rock candy and sought out the information on his own. Later, I was equally surprised when Keara engaged in her own discovery of water, ice, sugar, and drink mixes. Both children displayed natural curiosities and sought out to find more information. These parent-child interactions and investigations of questions about the natural world can cultivate curiosity. Even more importantly, the children were able to locate and use resources (i.e., computers, cameras, technology, books) to seek out answers to their questions.
Chapter Six: Let’s Talk: Science Communication

I do not remember talking about science as I was growing up. Furthermore, we rarely engaged in conversations related to my schooling and education in general. As my educational endeavors began to expand, I began to feel more and more as an outsider in educational settings. As a consequence, I do remember having these outsider feelings during my secondary and college educational experiences. This occurred mainly during group classroom discussions; this was especially heightened around others who I deemed to be experts with many experiences and prior knowledge, something I felt I was very limited in. The feelings of being an outsider continued throughout the majority of my doctoral program, as I rarely felt smart enough to take part in the doctoral academic talk. I mainly felt other students in my doctoral cohort were well read with diverse backgrounds and experiences. The way in which they communicated (mannerisms, examples, and vocabulary) was challenging for me – this inhibited my willingness to take part in the discussions because I felt less knowledgeable. The field of science is another field that often leaves individuals feeling as outsiders (Gallas, 1995; Lemke, 1990, Newton, 2003). Similar feelings of being outsiders in discussions about science and education might be avoided by engaging children in science communication.

As stated previously, I have decided to take a different educational approach with my own children. As a family we engage in conversations, we provide informal educational experiences for our children; we take their ideas seriously, including their conversations and questions. We want them to talk, discuss, and learn academic language, including science talk because our interests are positioned in many areas of science. As we explore the world around us, we do this in the same style as Harlen (2001)
by asking the child to give their reasoning. You can do this by asking the child, “Why do you think that?” and “Can you tell me your reasons?” (Harlen, 2001). Whether the answer is right or wrong, our children develop reasoning and communication skills based on their observations of the natural world. This is a sharp contrast to my memories of talk with my own family. For example, when I was growing up, we would plant a large vegetable garden. Gardening, for us, mainly consisted of chores and duties, as we never discussed plants, flowers, seeds, or the science involved in the maintenance of such an endeavor. As a child, I don’t remember having a voice or family conversations in the process of planting, placement of plants, canning, fertilizers, sprays, and so forth. As I fast forward to my children, one summer we built a raised bed in our backyard for planting vegetables. As a family we had discussions of the need for a raised bed with our compact clay soil. I set up soil displays, see Figure 6.1, with the children so they could see different components of various soil types. A soil display is made with a jar, soil, and

Figure 6.1. Soil Displays
water. This is a simple experiment, by first adding different types of soil to empty jars. Any amount of soil will work, as long as the jar is not filled. Next add enough water to cover the soil and tighten the lid on the jar. Lastly, you shake the jar, place the jar on a shelf, and do not move until the contents settle. The soil will separate by density into the different layers of sand, silt, clay, and humus. We maintained and used compost for our planting needs and discussed the reasoning for composting. That first summer with our new raised bed, we planted tomato plants, pepper plants, and a lone cantaloupe plant. Noticing the cantaloupe plant’s flowers, Sean inquired about the plant.

Sean: why do these cantaloupe flowers keep dying?
Glenda: After they are pollinated, they die to make way for the fruit to grow.
Sean: Oh (walking over to closely inspect the tomato plants), look at these small green tomatoes on this plant.
Glenda: Yes, a flower was there first. (Glenda turned to focus on weeding the area, as a neighborhood boy, Michael, about 3 years younger than Sean, approached).
Sean: Michael, come here this is where the cantaloupe forms. Look closely at this. This flower is dying; now, the cantaloupe will begin to grow here. (Field Notes, 6/17/2010).

Sean asked a question, I responded to the question. We talked about the science, and then he immediately turned around to become the expert with a younger boy in the neighborhood. In our house, we try to take all inquires seriously. I have taken the time to listen to them so they can develop reasoning and communication skills. Here, by
engaging children in the conversations of science, the learner becomes the expert and is able to teach in and out of the language of science (Lemke, 1990).

From my experiences as an educator, I have noticed children become interested in authentic experiences, where they are invested in the project. For example, my children were invested in the care and observations of the anole we brought home from our Florida vacation. When we returned home with the reptile, we had Sean develop the habitat, water, feeding, heat source and the like. For the three years the anole lived in his bedroom, we had inquiries after inquiries about the habitat and behavior of the organism, such as watching the anole eat. Throughout the three years, we never grew tired of feeding the anole live crickets. Another example comes from a good friend of mine. As my friend was beginning her teaching career she observed an occurrence at the beach with her young child. For two hours, the child dug a hole and would run to the ocean to collect water, pour water in the hole, for the hole to never fill with water. The child never grew tired of her futile efforts to successfully fill the hole with water. After watching the child’s unsuccessful efforts throughout the afternoon, my friend commented that “If I would have told that child to dig a hole and be sure to fill it to the top with water, the child would have bored of the activity after a few short unsuccessful attempts”. Here, upon her own accord, the child played and investigated for hours uncovering the mysteries of sand and water. My friend wondered how she would capture that same curiosity in her classroom (Personal conversation, 03/22/2010). In this chapter, I will illustrate the ways that my family was able to communicate, both verbally and nonverbally, through science.
Science Talk

In communicating science, talking is a vital aspect. According to Jay Lemke (1990), he refers to “talking science” as observing, describing, comparing, classifying, analyzing, discussing, hypothesizing, theorizing, questioning, challenging, arguing, designing experiments, following procedures, judging, evaluating, deciding, concluding generalizing, reporting, writing, lecturing, and teaching in and through the language of science (p.1).

Whereas Lemke (1990) focuses on the importance of high school aged learners talking science for sense making and understanding in the classroom setting, Gallas (1995) says for you to be successful at the secondary level and beyond, you have to talk science with young children. As with Lemke and others (Gallas, 1995; Harlen, 2001; Newton, 2003), I agree that communication is a vital aspect of the progress of science learning. Talk includes uncovering the child’s prior knowledge, making reference to science process skills by highlighting their observations, inferences, and predictions, making explanations, monitoring learning, and basically having conversations (Eberbach & Crowley, 2009; Gallas, 1995; Harlen, 2001; Newton, 2003). Therefore, I have captured my children’s science talk as we have explored the world around us and our experiences, by following and documenting our investigations and explorations. I consider talk as the ways we communicated science, through verbal and nonverbal means.

One day, as we were riding in the car, Keara recalls her experience of seeing a bat.
Keara: I saw a bat the other day.
Glenda: a real bat? Or a baseball bat?
Keara: Yes, a real bat that flies like a bird.
Glenda: You know they are mammals, not birds.
Keara: Oh, what are mammals?
Glenda: Animals that have hair, like us, we are mammals, and bats are mammals.
Sean: Yeah and they don’t lay eggs either.
Glenda: Keara can you name some mammals?
Sean: She can’t name any, she doesn’t know any. Name one Keara, name a mammal!
Keara: [smiling] a bat [looking confident and self-satisfied], a bat is a mammal (Field Notes, 02/15/2012).

That day, as I was very proud of Keara for using her voice, I was equally as proud that both children were able to talk science. According to Lemke’s (1990) framework for talking science, they both talked science. Keara uses observing, predicting, inferring, questioning, and reporting. Keara recalled her observation of seeing a bat, and then made the prediction and inference of something “that flies like a bird.” She frames a question around the conversation, “What are mammals?” Lastly, she does reporting by communicating the factual knowledge of naming a bat as a mammal. Sean used reporting and challenging. He reported additional science factual knowledge by adding that “they don’t lay eggs,” and further challenged Keara to name a mammal. Keara is learning new terminology using a close analogy (bird) but she quickly uses it to get the best of her brother. Sean on the other hand has mastered that particular terminology and is sharing
his knowledge (or at least implying that he has greater science knowledge than his sister).

Finally, Sean infuses the conversation with little tidbits of his own knowledge by mentioning the egg laying which I did not mention. He listened to what was being said and added more information, not repeating what had been said.

Sean continues to actively pursue science knowledge through investigations and questions, often sharing his ideas and thoughts, such as a time we visited a local nature center. We occasionally visited this nature center for leisure walks along their paved pathways and explorations in the visitor’s center. As we were walking along one of the hiking trails, Sean notices a mushroom with a shiny, reflective look to it.

Sean: I wonder if things will stick to it [a mushroom]? (Picking up nearby objects on the ground, found near the mushroom, he places a brown leaf and small rock on top of mushroom cap).

Keara: (Walks over to observe Sean) something peed on it.

Group: (Laughing).

As we continue on the nature walk, Sean takes photographs of various natural objects along the path. After we finish the walk, we go to the visitor’s center and look at native plants and the interpretive signage along the front of the building. Sean begins taking photos of signage and of a small purple box attached to the side of a large tree. Denny reads the sign, which is the signage near the purple box. This box describes the issue surrounding the invasive Emerald Ash Borer Beetle, an insect introduced from Asia that feeds and destroys Ash trees.

Sean: I bet there is sticky stuff inside the box (referring to the purple box).

Glenda: Why do you think that?
Sean: So the emerald ash beetle will go inside and get trapped.

Glenda: Oh, why would you want to trap the beetle in the box?

Sean: So, it doesn’t harm the trees (Field Notes, 9/13/2009).

Sean begins by questioning. By using the questioning and wondering framework of Harlen (2001) he frequently asks questions by this, by “wondering.” After his initial observations, he questioned if the mushroom is sticky, in which he investigated the stickiness of the mushroom. Here, Keara observes Sean’s curiosity and make an inference about the mushroom, where she states, and “Something peed on it.” Sean continually observed the world around him, as he walked along the path, taking photos of objects he noticed. Sean has become accustomed to using his technology tools for his observations. Very quickly, Sean noticed and wondered about the purple box, in which he immediately made an inference by stating “I bet there is sticky stuff inside the box.” Upon my prompting, asking him to expand his observation and inference of the purple box, he advanced his science skills by making predictions. Sean used knowledge collected first-hand and observations to make a prediction as to the reason a sticky substance might be found inside the purple box.

**Conversations with others**

Another essential component of communication is sharing that knowledge with others. Whereas Lemke (1990) focuses his research on the classroom setting, stating in order to be a successful learner in the classroom, one must have conversations around the organized activities typically found in the classroom, Gallas (1995) recognizes the importance of engaging young children in science conversations in order for a child to become successful at the secondary level and beyond. Throughout the duration of this
study, my family has engaged in science talk with others. For example, immediately after beginning this research project, we went camping with some family friends. Sitting around the campfire, Sean gives a detailed, page by page account of a book about penguins he had listened to at school (Field Notes, June 20, 2009). All adults were very impressed with Sean’s recall knowledge of the read aloud from class. I, being unfamiliar with the book, sat in awe and wondered how I would capture the daily science interactions of my family for this project. In a different conversation with an adult in our home, Sean sought out science information to share with such adult friends and me. As a friend and I were planning activities for leading an educational trip to Alaska, Sean was upset that he could not go on the trip with us. Sean, frustrated that he couldn't go to Alaska, stated that he would then save his money for a trip to the Galapagos Islands. Later, he went to our book shelves and removed a field guide book on North American Wildlife. After finding a page to share, he came back to the room in which we were planning our activities for Alaska. Abruptly, Sean places the book on the table with the page open to a Lynx, in which the map of North American and the lynx’s region is Alaska. Sean states, “You might see one of those, and I want a picture.” (Field Notes, 08/02/2010). Sean was talking science with us; upon his disappointment, he sought out information to share with us, so that he could talk science with the adults. Not only did Sean know what kind of book to use but also how to use it. He can read science to contribute to science conversations.

Other times Sean was eager to share his science talk with neighborhood playmates. When a younger neighbor comes into our house to play, she notices Sean’s Lego® ships that he had designed and built on his own. The younger playmate comments
on the ships, when Sean states, “It’s pretty good, I mean, I didn’t have an engineer build it, but it’s pretty good” (Field Notes, 10/15/2009). Later, the same younger girl was walking with us around our neighborhood collecting leaves. Under my guidance, I had all the children observe the vein patterns in each of the different leaves. Later that evening, Sean mentions that he would like to take the leaves to school the next day. The next morning, as we were getting ready for school, Sean gets a bag and goes to collect the leaves from the patio table. He gently placed one leaf at a time in bag. After selecting six of the largest leaves, Sean said, “I got six of these, one for each table in my classroom, so everyone can look at them” (Field Notes, 10/16/2009).

One time, while driving in the car, Sean decided to share his science knowledge with me, after he observes the moon and sun in the sky. Sean made one hand in a fist as the Sun and the other fist the Earth; he begins turning his hand in a circular motion.

Sean: (Pointing) the moon should be over there.

Glenda: That is interesting. What makes you think it is located there?

Sean: Well, it should be opposite the sun.

Sean: (We make a turn in the automobile and now are traveling a different direction. Sean observes the moon directly in front of us; he jumps to look to my left.) South, the sun is in the south.

Glenda: that is interesting Sean. Why do you know that?

Sean: see when the earth is like this, we would be here [points to the side of hand away from sun] and it would be night time.

Glenda: Oh, okay.

Sean: Then the Earth keeps turning around and then it is day light.
Glenda: Nice job, Sean, yes. Then the Earth also moves around the sun like this (shows with hands).

Sean: Yes, I know.

Glenda: You know Sean; you would be a great scientist.

Sean: Really, why do you say that?

Glenda: Sean, scientists just like you make observations and predictions like you just did. That is amazing and pretty cool. You are observing the world around you. I love that.

Sean: Oh, a scientist, just like me. You are a scientist, what makes you a scientist?

Glenda: For the same reason, I observe the world around me and make predictions (Field Notes, 10/29/2009).

Here Sean shared his thoughts about the sun and moon with me. I listen to him talk and added talk as needed. I told Sean he was a scientist, as I wanted him to be comfortable in the world on science.

Writing

Just as talking is an important part of learning science, writing about science is equally important. I haphazardly discovered the power of journaling as we drove through endless cornfields of southern Indiana. Although I soon discovered journaling to be a way to entertain two very small children in the backseat of our car, once the trip was over, I noticed how significant the journals became to our life. These journals were a way to continually relive our experiences, talking of our adventures, and discussing our questions and experiences. Drawing on the work of Lemke (1990) and other researchers
focusing upon classroom talk, Gallas (1994) argues that children must relate their personal stories to the learning of science. As she encourages young children to utilize science journals, in which children draw and write and hold “personal conversations” with the world around them, or as Gallas puts it, journals become the critical place for children to develop “thinking and reasoning rich in association, personification, metaphor, and analogy” (p.79).

Notebooks can be a record, an extension of children’s mental activities, storing personally valued information. They contain drawings, tables, and graphs, and “are an essential item in the children’s scientific tool bag” (Harlen, 2001, p.100). Drawings are a means of self-expression, a way to communicate before the child can write the words. I felt that family journals would be a way to create family keepsakes during our travels. When traveling, I am usually the keeper of the family journal with a small collection of pencils, colored pencils, markers, and crayons. I keep the journal and writing in a small backpack. Throughout the car ride, we would add drawings to our family journal of the states we were in, interesting signs we encountered, and really anything that seemed interesting to the person with the journal. Occasionally, Denny and the children would ask for the journal to document their findings, and at times, I used the journal to aid in the boredom of a long car ride. When the children seemed to be restless in the car, I would hand the journal to them and ask them to write and draw.

On a summer vacation trip to Hilton Head Island, we started a family journal on the car ride to our destination. Once we arrived to our beach destination, we continued journaling about the condominium, the pool, the beach, incorporating activities and incidents that occurred. Below, is a drawing of our encounter with numerous skates while
we were swimming in the Atlantic Ocean. Here, the words state, “We saw a skate,” with a very simple drawing of a skate, see Figure 6.2, which was made by Sean (Field Notes, 06/18/2009). According to Lemke’s definition of science talk, Sean is describing his connection to the world around him.

![Figure 6.2 Drawing of a skate from family journal.](image)

To this day, the children will look at the journal entry and make references to the time when we were swimming in the ocean with a school of skates surrounding us. This places the learning into context. By reflecting on the experience they can recall other memories from this occurrence, such as the image of a skate and the smell and the feel of the ocean, which may not be adequately described and/or remembered by a young child. Drawing in science will help children to observe, remember, and communicate (Harlen, 2001), just as drawings are key products of a scientist and understanding science.

Drawings were another way we would engage in scientific conversations. One day Sean decided he would like to combine animals to make a new organism. Drawing
allowed him to express himself, since he was a reluctant writer. Sean is showing basic levels of hypothesizing, with the creation of a new organism. We would take turns drawing an organism and combining them to make a new one, see Figure 6.3.

![Figure 6.1 Fictitious Animals](image)

Although Sean was reluctant to write in the formal school setting, he would rarely hesitate at journaling, drawing, and constructing stories at the computer. At various times, Sean would go to the computer to write science stories and upon one occasion he made a PowerPoint, something he learned from school, for one science story. The image below shows two of Sean’s stories. The first story is of that of an iguana. Sean would decide upon the story, find a photograph, and print the story to mount on construction paper. The second story is about a bald eagle, birds that Sean is passionate about. These stories illustrate the transition from fact to fictional stories.
Jaguar and His Green Iguana

Once there was a iguana, that lived on the island of St. Thomas hanging around the rocks on the shore.
And a boy named Jaguar found it and he wanted to keep it.
And whenever he brought him home they played together.
Jaguar fed him some fruit. And built him a home out of sticks.
Jaguar had a big big bucket that he filled with water so his pet iguana could swim.
The End.

Source:
http://www.greenisgsociety.org/inthewild.htm
Salamander Room

Tiger and the Philippine Eagles

Once there was a Philippine eagle that lived in the forest
and he liked to eat monkeys. And he found a person.
And the person was named tiger.
The person liked the Philippine eagle,
so he kept him. And took him home
and played with him. And he fed him fish.
Tiger found another Philippine eagle.
And the eagles played together.
The end.
-Sean McCarty 01/18/2010
I was surprised Sean would want to write a story, see Figure 6.4, in which he initiated the idea of putting a story together on the computer. This is the first time that we had tried something like this. We had done some nature journaling and journaling on road trips, with this being initiated by Sean and him doing most of the work. I provided promoting for Sean, especially with the Iguana. A few years earlier, we had brought home an anole from our Florida vacation. I tried to connect this story writing to Sean's prior knowledge. I also referenced the book, *Salamander Room* by Anne Mazer, something we had read many times over the years. I encouraged Sean with questions,

What type of iguana?

Where does the iguana live?

What would this type of Iguana eat?

We used the Internet for this research, (http://www.greenigtsociety.org/inthewild.htm, 01/18/2010), which described a green iguana on the Caribbean islands. Below is the story that Sean wrote:

Jaguar and His Green Iguana

Once there was a iguana, that lived on the island of St. Thomas hanging around the rocks on the shore.

And a boy named Jaguar found it and he wanted to keep it.

And whenever he brought him home they played together.

Jaguar fed him some fruit. And built him a home out of sticks.

Jaguar had a big bucket that he filled with water so his pet iguana could swim.

The End. (Field Notes, 01/18/2010).
Sean continued to write another story, this one about eagles, his favorite bird. Below is the story that Sean wrote:

Tiger and the Philippine Eagles

Once there was a Philippine eagle that lived in the forest and he liked to eat monkeys. And he found a person.

And the person was named tiger.

The person liked the Philippine eagle, so he kept him. And took him home and played with him. And he fed him fish.

Tiger found another Philippine eagle.

And the eagles played together.

The end. (Field Notes, 01/18/2010).

Sean's transition to fictional stories was self-initiated, as Sean was a reluctant writer in school as well as limited in writing in our family journals. When Sean began writing the stories, and asked for help, I suggested to Sean to include accurate scientific information in the story. Although the story is fictional, I wanted accurate scientific information. For example, he mentioned to feed the iguana apples and I said we should look it up to see what they eat. We found an Internet source to gather the information, and Sean did incorporate factual information into his fictional story.

There are affordances to using technology and constraints when writing is only tied to personal experience, as well as my personal constraints of valuing accurate scientific information. Sean was able to pull from his prior knowledge of our pet anole and information from the numerous readings of Salamander Room. Our affordances came
into play with our access to technology and my science and literacy background. In creating our home environment rich in science and literacy, the home journaling allowed the children to be unconcerned about any lack of knowledge they might not have. Journals encouraged them to share what they were experiencing as well as to go out and seek more information to include. When you have technology to do research, which is beyond your normal knowledge level, you can create a story beyond your knowledge level, which creates affordances that others might not have.

**Summary**

Talk, being a way to support understanding in science, is important among young children as well as adults. With our children, as we explore science and make meaning of the world around us, we felt it was essential to foster their talk. This was easily encouraged through conversation as we explored the world around through our observations, inferences, predictions, and questions; through conversations with others outside of the family; and, by writing and drawing about science.

We used science talk around experiments we set-up and explored in our home, such as the soil displays. The soil displays were created by each of us and then left to sit on the kitchen table for observations and possible conversation. We had conversations in our car, from something as silly as Keara’s naming a bat a mammal in spite of Sean’s challenge. At other times, during purposeful explorations, such as the explorations of the sticky mushroom and the Emerald Ash Borer Beetle at a local nature center, Sean and Keara both were able to make observations, inferences, predictions, and questions about the world around them. As parents, we aided in their explorations and observations by prompting and supporting them in their science talk.
In conversations with others outside of our family, Sean was able to impress our family friends at a camping expedition with his recall of a storybook read aloud at his school. Although I had not read that book, Sean’s recollection of the book was portrayed with vivid descriptions and summarization of the content. Later, Sean was able to impress a friend with his capability to select a science information book from our book shelves to add to the conversation about visiting Alaska. Sean, being eight years of age at the time, was able to use a field guide to accurately locate a mammal that lived in Alaska and asked the family friend to try to get a photograph of one.

Lastly, writing is another opportunity for science talk. Both children were able to participate in family journaling during our vacations. During vacations, we each participated in writing and illustrating the world around us. Although I initiated the journaling activities and brought along the supplies, each person was free to expand on their own ideas and observations. At times, we would have drawings of maps or the hotel swimming pool. Yet, at other times, I would capitalize on the science drawings the children chose to include, such as the illustration of the skates that were in the water with us while swimming in the Atlantic Ocean. Other than the family journals, Sean was interested in drawing fictitious animals and creating science stories. Both times, I allowed Sean to explore his interest by participating and providing support as needed. During the development of his science stories, I introduced norms such as proper science references and fact checking. This was to be sure the fictional stories did contain factual information. Writing was another way to encourage science conversations in our home.
Chapter Seven: Discussion and Final Remarks

I began this study with the guiding question: How does my family foster science learning? As well as the sub-questions: What are the ways we participate in and interact with science on a day to day basis? How is science shared and portrayed? How is sense-making experienced by the family, mainly the children? I have pursued these guiding questions to illuminate how my family interacts with science and literacy on a daily basis with the hope to provide educators, parents, and child care providers with an understanding of the capabilities of young children and to illuminate the ways in which children can learn science. In this chapter I will review my interpretations, discuss the outcomes, and suggestions for future research.

Transforming your world

I have often felt the disadvantages of my childhood. Thought about the things I had missed out on, especially when friends would talk about their childhoods and have these vivid memories of all the wonderful experiences they could recall. How I wished that would have been my childhood. Looking forward, I decided that my own children would have a much different childhood than mine, from reading aloud to them, to museum visits, to backyard explorations, to asking them questions, to listening to them talk about their interests and questions. With that being said, for this final chapter of the dissertation, I move away from my own background to the current implications of this study in hopes that other parents, educators, and childcare providers can take away ideas and information; and lastly to include future research interests.
In the *Pedagogy of the Oppressed*, Freire (1970) says learners should be treated as co-creators of knowledge, not empty vessels that need to be filled; he goes on further to say,

Education either functions as an instrument which is used to facilitate integration of the younger generation into the logic of the present system and bring about conformity or it becomes the practice of freedom, the means by which men and women deal critically and creatively with reality and discover how to participate in the transformation of their world. (Freire, 1970, p.36)

It is clear that learning is all around us and runs much deeper than primarily within the walls of formal schooling. Learning occurs across the life span, from infancy through adulthood, because individuals are curious and want to learn about the world around them. As educators, parents, and child care providers, it is essential that we capitalize on these learning opportunities with young children.

This research study has illuminated the ways this family fosters science learning, by the ways in which science interactions occurred around literature and read alouds, self-initiated inquiry, and communication. These three areas are discussed in the next sections of this chapter.

**Sharing books and reading aloud**

I read to my children for the educational benefits. It wasn’t until I interviewed Denny for this project that I discovered that he doesn’t necessarily read for the educational benefits, as his intent is to spend time with our children. There are many reasons one decides to read to children. Being a mom and an educator, I know of the educational advantages that are provided to young children that engage in read alouds
from a young age (Teale & Sulzy, 1986; Taylor & Dorsey-Gaines, 1988), including setting the stage for emergent literacy and, ultimately, lifelong learning.

Providing a literature rich home is essential. At one count, we had over 300 children’s books in our home, not to mention the numbers of our adult books that occupied our shelves and tables. By modeling and using books in our home, both children were able to use the literature in their day to day life. By selecting a field guide from our book shelf, Sean was able to find the information that he needed and wanted in proving his point regarding my trip to Alaska. Keara used information from a fictional storybook to successfully answer questions about the types of rodents for a board game. Sean successfully climbed a rock wall because he related to a boy from a storybook. Keara, reluctant at first, engaged in reading a nonfiction magazine on caterpillars and butterflies after I made a connection to one of her favorite storybooks. Sean and Keara, like many children, encounter many different kinds of text in their daily life. Nearly all children, including children from low SES backgrounds, have regular exposure to print in their homes and communities (Teale, 1986) and develop important literacy knowledge as a result (Purcell-Gates, 1996). In addition, being aware of genres young children encounter at home and at school offers opportunities to bridge home and school literacies (Duke & Purcell-Gates, 2003), as well as science literacy, and ultimately may enhance children’s literacy development.

Furthermore, both children continually make text-text, text-self, and text-world connections (Keene & Zimmermann, 2007). Proficient readers think about their previous knowledge, other texts they have read, their personal experiences, and make connections with the text they are reading. Students are encouraged to use these intertextual
connections to aid in reading comprehension. Yet, reading is not enough, you must combine children’s questions as well as your own to help children make connections and gain a richer understanding of the text and the world around them. In these interactive read alouds, for a young child, interpreting the text is an ongoing negotiation between the child and the more experienced reader (i.e., parent or teacher), who directs the child’s learning to distinct aspects of the book, thus aids in construction of language and the conventions of books (Cochran-Smith, 1984; Heath, 1982).

Sharing stories that were connected to my family’s daily life may support my children in building a plethora of foundational knowledge for their educational endeavors. Readers who bring prior knowledge to a text are able to generate more meaning than readers who do not possess this prior knowledge. Keene and Zimmermann (2007) suggest that when “we read, we stretch the limits of the literal text by folding our experience and belief into the literal meanings in the text, creating a new interpretation, an inference” (p.147). Children’s understandings of print and how it works are built through their own experiences with different genres of written language.

 Sharing science read alouds with young children provides context for engaging in science activities and learning. Sean and Keara’s use of science information books represents the richness of this meaning making process for science literacy. They claimed ownership of their learning by integrated ideas presented in texts into their daily life and using different texts to find answers of the questions they asked. This supports that younger children are capable of handling the information genre in their home and in schools. Furthermore, children and teachers are greatly disadvantaged when they are
denied rich literature with content information that children might use to read, write, and think (Palincsar & Duke, 2004).

For educators, being aware of home literacies may be one way to help children make the connections between what they are learning in school and what they do in the home. For children whose home literature experiences do not include the genres typically used in the formal school setting, they may be at a disadvantage when it comes to learning the new material at school. It may make sense to find ways to connect the school literacy to the home literacy, thus making intertextual connections across home and school (Duke & Purcell-Gates, 2003). Teachers can expand both of the child’s worlds, home and school, by building upon school literacy and drawing upon the child’s home literacy to create learning connections.

This emphasizes the importance of the home as a rich social context for children’s literacy development and potential learning. In our home, by making books and reading a natural part of our life, we discovered knowledge from our exposure to science literature. At times, we made compromises with our book selections, yet both fiction and nonfiction played important roles in our day to day happenings. We read our beloved storybooks over and over, providing hours of entertainment, comfort, and security; whereas, information books offered us realistic situations and experiences for knowledge construction.

**Self-Initiated Learning**

How much time does a person spend in formal schooling? My maternal grandfather spent one year in formal schooling, my maternal aunt eight years, my mother 10 years, my father 12 years, and I will have completed my twenty-fourth year of formal schooling at
the conclusion of this degree. When you stop to consider our average human life expectancy, a tremendous amount of time is spent outside of formal schooling (LIFE Center: Stevens, R. Bransford, J. & Stevens, A., 2005). During this time, a person is self-initiating their own learning, to meet their own needs and goals. So, I find myself often pondering, what exactly should school accomplish? Does learning in the home and school need an intersection point?

According to the NRC (2010) it is clear that science learning takes place in many venues other than formal schooling. These venues include computer usage, watching television, museums and other informal institutions, after school programs, movies, and from adults. Although it is clear that each of these activities vary from setting to setting, they all share these five commitments:

1. To engage participants in multiple ways, including physically, emotionally, and cognitively;
2. To encourage participants’ direct interactions with phenomena of the natural and designed world largely in learner-directed ways;
3. To provide multifaceted and dynamic portrayals of science;
4. To build on learners’ prior knowledge and interests; and
5. To allow participants considerable choice and control over whether and how they engage and learn (NRC, 2010, p.17).

Ultimately, learning science is possible from plentiful sources other than formal schooling, called free choice science learning (Falk, 2001). Therefore, it is possible and necessary to engage young children, and families, physically, emotionally, and cognitively in science; promoting such early exposure may provide rich experiences and
ultimately afford the child a rich background with foundational knowledge for building upon in future years in and out of school. Sean and Keara, as well as Denny and myself, were physically participating in science experiments, visiting museums, and exploring various media formats. With this physical interaction, we developed emotional and cognitive engagements. Sean displays emotional attachments to his favorite animals, while both children displayed cognitive growth due to their interactions in science. Cognitive growth can be achieved through inquiry methods, which is one means of helping children to investigate their curiosity and questions through direct exposure to the natural world and designed world. A great deal of learning takes place across a range of social settings, beyond the walls of the formal classroom. In self-initiated science learning, young children are fully capable of observing the world around them, asking questions based on their observations, and finding the answers to those questions. They are capable of seeking out answers to their own questions.

As Gallas (1995) demonstrates, she was able to move her classroom from questions based on the teacher agenda to questions asked and led by her students. In my family, Denny and I were successful in much the same way as Gallas. We modeled questions and seeking answers to those questions, our form of inquiry, which led to the children asking questions and seeking answers. Inquiry methods can be varied and the outcome is determined by the researcher’s desire to learn. For us, inquiry meant asking and exploring questions you have about the natural world, questions that are developed due to your own curiosity and imagination. Although this is a little different from the inquiry I learned through the Exploratorium at the CILS program, there were times that we did have inquiry starters for the children. Due to our modeling and use of inquiry
starters in the home, the children were eventually able to self-initiated their own learning and inquiries. Keara’s inquiry may be somewhat limited due to her other interests, while Sean expands his notions of inquiry by his use of technology and his desire to experiment. But, in all instances of the data, they were able to answer their own questions, which is the point of self-initiated inquiry learning.

In order to become familiar with the Nature of Science (NOS), Lederman (2007) supports the seven crucial components of understanding, which were initially listed in the first chapter. Here, Lederman categorizes the NOS components as:

1. Understanding the differences between observation and inference.
2. Understanding and distinctions between scientific laws and theories.
4. Scientific knowledge is subjective and/or theory-laden.
5. Science and scientists are products of the culture.
6. Scientific knowledge is tentative and subject to change.
7. Scientific inquiry and NOS are intertwined, yet distinctly different.

Throughout this research my family focused on the components 3, 5, and 6, whereas the others are very formal and received little to no attention. In looking at component 3, children have vivid imaginations and much creativity. Sean and Keara brought their imagination and creativity to our science explorations and to their own self-initiated explorations. Curiosity is the first step in to developing scientific questions. Our goal was to offer our children many opportunities to be deeply involved in science by allowing them to explore their own curiosity and imagination. As we observed the world around us, our curiosity and imaginations were sparked, making science the prevalent culture in our home. As with a fully functioning member of any culture, a child needs to learn how to both produce and understand a wide variety of symbol systems for that culture (Callanan & Braswell, 2006). My goal was to offer my children as many opportunities as
possible to be involved in the culture of science, to fully explore and act upon materials and phenomena while posing questions that I thought would provoke their growth in thinking. It is this exposure that celebrated our not knowing and wanting to find out more.

Knowledge about informal learning opportunities has become a platform on which teachers can build upon in the classroom (Korpan, Bisanz, Boehme, & Lynch, 1997). This research project clearly documents science related learning opportunities in and out of the home and other informal learning places. Children come to school fully prepared to engage in science and science discoveries. Children’s spontaneous questions and curiosity should be the type of inquiry that we foster in the science classroom. It is desirable to preserve a child’s natural curiosity throughout the science curriculum so that it wouldn’t have to be re-taught in later years. Possibly, it is necessary to build upon this parent-child interaction of questions and investigations in the formal school setting, in order to meet our needs of cultivating student curiosity. It is important to note that Denny and I were facilitators of knowledge acquisition as opposed to mere providers of information (Korpan et al., 1997).

**Science Communication**

Social constructivist Bruner (2002) supports the role of narrative in cognitive development. Bruner argues that story making is central to creating an understanding of the world which a person can feel they will fit, and furthermore, all cultures have their own narrative story. Researchers have noted the importance of talk in the classroom (Barnes, 1976; Bruner, 1986; Cazden, 1988). Science researchers have documented the culture of science and scientists, while noting the role of language and argumentation in
science (Chin & Osborne, 2002). Osborne (2010) argues that science education should pay more attention to the crucial role of language in scientific work, and to teach children to use and understand scientific language. Callanan & Braswell (2002) state that children enter school with some aspects of the language of science, while Gallas (1995) note that children are fully capable to talk science in the elementary school. These studies highlight the importance that language plays in learning and science learning. Perhaps, science education should pay more attention to the language potential of young children in the teaching and learning of science.

An essential part of learning science includes promoting discourse (Gallas, 1995; Lemke, 1990). Young children can talk and write about science, especially when communication begins within their immediate world (Dyasi & Dyasi, 2004). With observable phenomena, young children are capable of communicating the world around them. Each discipline, i.e. subject area, steps into a world of its own, with its own insider language. As we learn that language, and become literate in the discipline, we are making the world of that discipline a part of us and the way we see the world. Lemke (1990) describes what science talk might be

\[
\text{Just as with any foreign language, fluency in science requires practice at speaking, not just listening. It is when we have to put word together and make sense, when we have to formulate questions, argue, reason, and generalize, that we learn the thematic of science. (p. 24)}
\]

His analysis illustrated the need for children to use scientific language, to talk science, and for educators to recognize that scientific theories are “a way of talking about a subject using a particular thematic pattern” (p. 126). Gallas (1994) developed a science
curriculum that started with what she saw as children's "personal conversations" with the world around them. Gallas argued that science is not learning technical terminology that will help the child "do" and engage in science for understanding and personal pursuit, but, rather that the indoctrination of a quest to “observe, experiment, talk, and write about the world.” Ultimately, Gallas maintains that schools at all levels need to allow children to use forms of expression that encourage them to develop personal connections with the aspect of science they want to study, rather than to distance themselves from it.

As a parent of two young children, I documented the ways that they were able to communicate science, through both talking and writing about the world around them, the connections that were made, and ultimately sharing their knowledge with others. With authentic experiences, such as the care and observations of the anole, Sean and Keara were invested in this science project. They were able to make decisions about the anole’s habitat and care and to make observations and predictions. In many incidents such as the anole and others, they used Lemke’s framework (1990) for talking science. They held conversation with other adults, friends, and younger individuals in this framework of talking science. They encountered opportunities to write about science through the use of a computer (Sean’s stories) and journaling (family journals), writing that mimicked that of a scientists. Most importantly, Sean and Keara asked questions that originated from their explorations of the world around them. This wonder was shared through their talks and captured in their journaling and story writing. All this ultimately gives both, Sean and Keara, a familiarity and comfort in their world and may give them an advantage when learning in the formal school setting.
My family’s science communication is something that is often overlooked in schools. Our talks were rich in thinking, reasoning, personification, and analogy, and crossed the barriers into science and literacy. Typically, these types of oral and written narratives are not found in the schools, as children find themselves sitting neatly in rows and compartmentalized into science, history, geography, and literacy. Dyasi & Dyasi (2004) and Gallas (1995) state that science should be taught in a way that engages young children in observing, experimenting, talking, and writing about the world. As a parent of two young children, I did just that. I was there to guide them by asking questions, seeking answers through experimentation, making connections from previous experiences, and most importantly, allowing them to fumble their way through explanations of the world around them. Explanations that were developed over time, not dismissed or praised based on whether they were right or wrong. My ultimate motivation was to indoctrinate them into the world of science, to make a lasting foundation, which we can continue to build upon. As I stated my earlier, I am not interested in my children pursuing careers in science, as I believe that this type of questioning and observing will lead to creative and critical thinking in all disciplines in the formal school setting and eventually into adulthood.

**Community of Learners**

This research project looked at the sociocultural approach inspired by both Dewey (1916) and Vygotsky (1930/1978) and further explored by Heath (1983) and Rogoff (2003). John Dewey (1938) stated the goal for students is to “learn to act with and for others, while you learn to think and to judge for yourself” (p. 98). Ultimately, it is essential to encourage individual development while developing cooperative and social
practices. This integrated approach is linked to the context of everyday activities where children learn about the world around them (Heath, 1983; Rogoff, 2003). The interdisciplinary approach of informal learning, whether in the home or informal learning centers, is consistent with the sociocultural approach to human development. Rogoff (2003) argues that children develop as they participate in everyday activities.

I am grateful to Paulo Freire with his emphasis on dialogue and his concern for the oppressed, for giving the expression “reading the word, reading the world,” where his views of literacy demands a reading of the world (1985). Freire’s pedagogy is one of learning to ask questions. It is clear that learning science is possible from plentiful sources other than formal schooling. Therefore, it is possible and necessary to engage young children in science, promoting early exposure which provide rich experiences and ultimately give the child a rich background and foundational knowledge to build upon in future years. In final thoughts, parents, educators, and childcare providers interested in promoting science and literacy should incorporate the following suggestions:

- Acknowledge and encourage your child’s interests.
- Encourage your children to observe, ask questions, experiment, and seek understanding.
- Foster their natural curiosity to foster lifelong learning.
- Provide frequent opportunities for science learning at home and outside the home.
- Provide access to resources in your home, libraries, and informal science institutions.
- Take children’s ideas seriously, and learn alongside with them.
This can be achieved through inquiry methods, which is one means of helping children to investigate their curiosity and questions about the world around them. Inquiry methods can be varied and the outcome is determined by the researcher’s desire to learn. Science literacy is more than being able to produce and interpret scientific explanations, since it encompasses critical thinking and problem solving skills. As you read the world around you, create a foundation and continue adding to that foundation every chance you have.

Encourage children to discuss and share their thoughts and ideas. Encourage them to be open and free with their thoughts. Don’t get occupied in correcting children if they are wrong. Find other ways to discover the answers, by finding appropriate resources that can be utilized by the child and the family. Lemke (1990) says that “for most people, if these ways are learned at all, they are learned in the dialogue of the science classroom.” I have illustrated that young children can talk science and should be given the opportunities to talk science as they explore the world around them. Lemke (1990) goes further to say, “one single change in science teaching that should do more than any other to improve students’ ability to use the language of science is to give them more practice actually using it” (p.168). It is just as important to start these science conversations in the early years, just as other leading experts suggest (Eberbach & Crowley, 2009; Gallas, 1995, Harlen, 2001; Newton, 2003, Worth & Grollman, 2003).

Science is fundamentally a social enterprise (NRC, 1996). Scientists often work in groups and networks, communicate frequently, and often seek out information from other sources. The true work of scientists needs to be mimicked in the home, as well as in formal schools. Provide children with a notebook to keep track of their activities and observations. Try family journaling for family trips and outings. Ask questions that
originate from the journal. Find time to interact with the journals. Ask children to recall
the information and their thoughts. Offer suggestions to help them become organized and
to develop journaling habits that mimic those of the science field. These types of things
promote conversations and interactions around science learning.

Dewey spoke of the need to connect formal education to everyday experiences
(1900/1990). Informal learning opportunities are numerous and offer learners more direct
nonverbal experiences, objects and visual displays, instead of discourse to relay
information (Falk, Koran, & Dierking, 1986). Informal leaning centers can engage
students to experience science in ways uncommon to the classroom. Perhaps, formal
schooling should take note to the ways informal learning occurs and how it can promote
science learning in the classroom. Collaboration between the two, informal and formal,
would enable both to more effectively contribute to science learning and ultimately,
science literacy.

Providing childcare which is educational, as our childcare provider said, “I don’t
teach science lessons,” but she explored the world around the children’s life which was
rich in science and literacy. It wasn’t formal science lessons they were engaged in, it was
everyday life, exploring, critical thinking and socialization.

Finally, encouraging science and literacy learning is to provide support to children
around their natural curiosities of their world. Something as simple as digging up
earthworms in the yard and making observations can aid in the progression of science
learning with children. Or, when your child’s world revolves around dinosaurs, take them
to the public library and check out every book you can find, watch movies and
informational programs about dinosaurs, read information from the Internet, and take
them to see fossils and replicas...let their world be dinosaurs. Modeling lifelong learning is essential, even beginning at birth is necessary. Once children start school, support their education, as teachers cannot achieve the same results without the help and support from families.

**Future research**

I have initiated an interesting study in science learning but more research is needed at this critical time in our history. The home learning opportunities are enormous, as children do not enter school as empty slates. Therefore, more research is need that looks into the connections between informal home learning and formal school learning. More research is needed to bridge the gap between home and school, which further advances the sociocultural development of children. One way to shed light on the ways families can support formal schooling is to explore the relationship and happenings at family science nights in the formal school setting.

Given the current status of the lack of science teaching in our schools, the opportunities for informal science learning should not be ignored. There are many opportunities for research in the informal setting with students, young children, and families. For example, research that focuses on the support that informal learning can provide to students in formal educational setting is highly needed. As well as, there is a need to illuminate learning strategies that will support families and students while they are visiting informal learning centers.

I am interested in pursuing future research in the family science arena, including this same kind of ethnographic case study with families that do no classify themselves as a “science-oriented” family. I plan to analyze the science and literacy happenings in their
daily life. As disclosed previously, at the time of this research study, my family lived in a medium-sized city with many affordances for science and cultural institutions, nature centers, and public libraries. In the future, I plan to look at families that are in remote areas, without those resources and affordances so readily available.

Lastly, another variation on this topic includes focusing my research efforts on how families with young children interpret science. This may help educators to understand the ways that science is viewed in social settings outside of formal schooling and ultimately change curricula. Lastly, as Keara is entering public schooling, I plan to research the interplay, yet the conflict, of the science activities in home versus science activities in the school setting.
References


LIFE Center (2005). "The LIFE Center's Lifelong and Lifewide Diagram". This diagram was originally conceived by Reed Stevens and John Bransford to represent the range of learning environments being studied at the Learning in Informal and Formal Environments (LIFE) Center (http://life-slc.org). Graphic design, documentation, and calculations were conducted by Reed Stevens, with key assistance from Anne Stevens (graphic design) and Nathan Parham (calculations).


Appendix A: Institutional Review Board

The UM-St. Louis Human Subjects Committee reviewed the following protocol:

Name: Glenda McCarty
Title: The Selection, Reading and Use of Science Information Texts in Informal Settings

This proposal was approved by the Human Subjects Committee for a period of one year starting from the date listed below. The Human Subjects Committee must be notified in writing prior to major changes in the approved protocol. Examples of major changes are the addition of research sites or research instruments.

An annual report must be filed with the committee. This report should indicate the starting date of the project and the number of subjects since the start of project, or since last annual report.

Any consent or assent forms must be signed in duplicate and a copy provided to the subject. The principal investigator is required to retain the other copy of the signed consent form for at least three years following the completion of the research activity and the forms must be available for inspection if there is an official review of the UM-St. Louis human subjects research proceedings by the U.S. Department of Health and Human Services Office for Protection from Research Risks.

This action is officially recorded in the minutes of the committee.
Appendix B: Field Notes Example

S - inquiry

S - “I wonder if things will stick to it (the mushroom)?”

J - picks up objects (on ground) around mushroom -
he picks up a brown leaf, + small rock and places each one against cap of mushroom. he is testing each object to see if anything will stick to it.

S - “nope, nothing sticks to it”

K - walks over and says “something ‘peed’ on it.
We all laugh and continue walking.

Throughout hike S takes pictures and wonders/question objects around him.
Back at visitors center
we look at native plants +
interpretation on front of
building.
S - takes photos of interpretation
one sign re: purple box on
tree
He asks about it. He
reads sign
S - "I bet the sticky stuff is
inside the box."
G - "why do you think that"
S - "So the fish will not
get inside and get trapped.
Continue inside the visitor
center.
S - plays with soil-streams
exhibit for a long time.
We sit and observe the bird.
natural area behind building.

We try to figure out how the bird feeders up high on the tree get re-filled with seeds.

We all notice the rope and pulley device attached to the tree. This is used to lower feeder to ground to be filled with seed.
Appendix C: Coding Example

Coding Used:
Self Initiated
Use of Technology
Parent Prompting
Literacy Opportunity
Hands on Learning

Field Notes
Date: 02/16/2010
Time: 3:20 p.m.

Setting: Sean gets home from school at 3:15 p.m. I check in with him to see about his day. Usually asking, “How was your day?” or “Anything interesting happen today?” After a couple of minutes of talking about his day, I turned on PBS (9-1) to a show about science. The host of the show, a young girl, is in the home of a young boy, about 5th grade, and the boy is showing how to make rock candy. The boy then shows his crystal collection. They then go to the American Museum of Natural History to visit the crystal collection there. After that (a week later), they return to the boy’s home to check out the rock candy.

Sean: I want to make rock candy.
G: Do you remember the recipe?
Sean: No.
G: I don’t either.
Sean: I will go look it up.
G: Where? What?
Sean: On the computer.
G: Okay. The computer is turned off, so turn it on on the tower and wait for it to start.
Sean: [leaves living room and walks down the stairs to basement computer room.
G: [walks into kitchen and begins unloading the dishwasher]
About 3 minutes later
S: mom, mom...
G: [walks downstairs to computer room]
S: [as G walks into room, S points to computer] There it is.
G: What?
S: The recipe. There is the recipe for rock candy.
G: [looks at computer screen and sees some instructions for making rock candy]. Yes, there it is. What does it say?
S: [reads the list, 2 cups water, 4 cups sugar, warm water, glass jar, pencil and string]
G: Okay, let’s go make it.
Sean turned on the computer, logged on under his name, went to Internet Explorer. His homepage automatically loads 2 websites, 1 tab is Legos and the other is PBS kids. Once this loaded, he went to Google, and entered “how to make rock candy.” When this loaded, he clicked on the first entry that about rock candy, scrolled down and found the recipe.

We went to the kitchen and gathered the needed supplies. We added the sugar and warm water to the jar. Sean stirred the mixture until sugar was dissolved. We then took the string and tied around the pencil. Sean measured the string with the height of the jar and cut off the extra. Sean placed the pencil across the top and let the string hang down into the mixture. We put the jar on the kitchen counter.

G: We can make observations all week. You know, Sean, this would make a great science fair project. We could change one thing and see what happens with them.
S: Awesome. We could change the size of the jar or the water or sugar. I can see which one makes the biggest crystal.
G: Good ideas. Let’s see what happens.