

ABSTRACT

Title of Document: GIVING CHILDREN SPACE:
A PHENOMENOLOGICAL EXPLORATION
OF STUDENT EXPERIENCES IN SPACE
SCIENCE INQUIRY

Christopher R. Horne, Doctor of Philosophy,
2011

Directed By: Dr. Francine Hultgren, Department of Teaching
and Learning, Policy and Leadership

This study explores the experiences of 4th grade students in an inquiry-based space science classroom. At the heart of the study lies the essential question: What is the lived experience of children engaged in the process of space science inquiry?

Through the methodology of phenomenological inquiry, the author investigates the essence of the lived experience of twenty 4th grade students as well as the reflections of two high school students looking back on their 4th grade space science experience. To open the phenomenon more deeply, the concept of space is explored as an overarching theme throughout the text. The writings of several philosophers including Martin Heidegger and Hans-Georg Gadamer are opened up to understand the existential aspects of phenomenology and the act of experiencing the classroom as a lived human experience. The methodological structure for the study is based largely on the work of Max van Manen (2003) in his seminal work, *Researching Lived Experience*, which describes a structure of human science research.

A narrative based on classroom experiences, individual conversations, written reflections, and group discussion provides insight into the students' experiences. Their stories and thoughts reveal the themes of *activity*, *interactivity*, and “*inquiractivity*,” each emerging as an essential element of the lived experience in the inquiry-based space science classroom.

The metaphor of light brings illumination to the themes. *Activity* in the classroom is associated with light's constant and rapid motion throughout the Milky Way and beyond. *Interactivity* is seen through students' interactions just as light's reflective nature is seen through the illumination of the planets. Finally, *inquiractivity* is connected to questioning, the principal aspect of the inquiry-based classroom just as the sun is the essential source of light in our solar system.

As the era of No Child Left Behind fades, and the next generation of science standards emerge, the students' stories are viewed through the lens of the scientific practices found in *A Framework for K-12 Science Education* (The National Research Council, 2011). The critical challenge for elementary educators interacting with this text is to find the lived meaning of giving children space in an inquiry-based experience.

GIVING CHILDREN SPACE:
A PHENOMENOLOGICAL EXPLORATION
OF STUDENT
EXPERIENCES IN SPACE SCIENCE INQUIRY

by

Christopher R. Horne

Dissertation submitted to the Faculty of the Graduate School of the
University of Maryland College Park in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
2011

Advisory Committee:
Dr. Francine Hultgren, Advisor and Chair
Dr. Sherick Hughes
Dr. J. Randy McGinnis
Dr. Steven Selden
Dr. Emily van Zee
Dr. Debra Neubert, Dean's Rep

© Copyright by
Christopher R. Horne
2011

Dedication

To Dad,
who gave me space to explore and learn while imparting his passion
for space.

Thank you, Dad!

In memory of Mom,
who showed me endless compassion and taught me the meaning of passion
through her zeal for God and life.

I miss you, Mom!

Acknowledgements

This space odyssey would not have been possible without the help and support of many amazing and inspiring people. A project of this kind is never encountered alone. I will not be able to fully acknowledge all the many names of those who helped, the endless acts of kindness given, or the gestures of encouragement and assistance provided by so many. All I can hope to do is give credit to some who have made an abiding impact.

Dr. Francine Hultgren, my advisor and committee chair, has traveled light years with me over seven adventurous years. Her ongoing encouragement cannot be overstated. I would never have finished without her commitment and countless corrections. Her passion for phenomenology has been transformational in my life. Dr. Emily van Zee poured herself into my growth and taught me to listen, changing me as a teacher and learner forever. Dr. Randy McGinnis modeled true passion for science in his teaching and prolific writing. I am also grateful to Dr. Sherick Hughes, Dr. Steven Selden, and Dr. Debra Neubert for their willingness to invest their valuable time to serve on my committee.

From my school district, there have been many advocates for this work including: Dr. Stacey Adamiak, Susan Alexander, Jason Anderson, Mark Bowman, Kim Day, Jeff Grills, Christine Hickie, Larkin Hohnke, Lara Keller, Steve Lockard, Marilyn Matthews, and Dr. Kimm Mazaleski. To Dawn Getzandanner, teacher specialist for elementary science, who read each iteration of my work, from beginning to end, I am in awe of her knowledge and passion for the work we do together in science education and thankful for her numerous contributions to this work. To Angie Waltrup, teacher specialist for elementary math, who stepped up in the home stretch, doing whatever was needed to get

our overwhelming amount of work done while I kept writing and writing, I am extremely grateful. To my longtime friend and colleague, now at Penn State, Mrs. V, I am thankful for her commitment to my work, never missing an opportunity to invite me in to spend time with her students in the elementary (and college) classrooms. To Mrs. Z I owe huge thanks for inviting me into her classroom and sharing her heart for all to see. And, of course, the loudest of thanks goes to the conversants involved in this study along with the many hundreds of other students who poured out their passion for learning and freely shared their wonderings during my decades-long exploration of the space science classroom.

To my Church family, including the camping group, the BLGE, my pastor, Dr. Richard Fredericks, the DRCC staff, and of course Matt Holbrook and the SOAP guys, I am humbled by everyone's countless prayers, helping hands, and continuous encouragement. I am also delighted by their gift of much deserved playful banter balanced with an outpouring of overwhelming grace!

To my brother, Gary, a role model throughout my life, I am especially appreciative for his passion for fun and for revealing to me the tenacity necessary to finish such a project. To Mom, who touched me with all her many prayers, I will never be able to fully articulate the depth of my gratitude. To Dad, I have been blessed by his continuous faith in me. To my children, Meredith, Joshua, Jonathan, and Melissa, who grew up with a Dad in graduate school as far back as they can remember, and who showed great care and support throughout the process, it is difficult to express how much they have done to shape my character throughout this season of life. To Marti, my lifelong love, who never stopped giving and caring, even when I was ready to quit, I am

nearly speechless. She deserves more credit than anyone, sticking with me through all the challenges and obstacles. I am blessed to have such a persistent supporter.

And, finally, to my Lord, my God, and my Savior, I am eternally grateful for the countless ways in which I was encouraged to press through the process, relentlessly challenged to go boldly while always being given a generous gift of inspiration right when I needed it most!

Table of Contents

Dedication	ii
Acknowledgements	iii
Table of Contents	vi
List of Images	xi
CHAPTER ONE: TURNING TO LIFE'S PASSIONS	1
Inquiry into Inquiry-Based Science: The Passion Begins	1
Selecting a Context for My Experience in the Space Science Classroom	2
Inquiry-Based Science as a Context for Student Experience	4
Using Curriculum as a Context for Student Experience	5
Looking Deeper into the Meaning of Inquiry	7
Living My Passions	8
A Passion to Tell my Story	8
A Passion for Space – Looking Up	10
A Passion for Space – Stepping Out, Finding Hope	12
A Passion for Teaching	17
A Passion for Change	18
A Passion for Learning	21
A Passion to Research	26
A Passion for Phenomenology	28
A Passion to Question	30
Connecting with the Passionate	31
The Passion of an Educator	32
The Passion of a Child	36
What is a Heartsong?	38
The Passion of an Astronaut	40
Finding the Connection: Passion	43
Space Science Inquiry – Using Phenomenology as a Guide	44
Turning to a Methodological Structure	46
Human Science Research as a Caring Act	48
Receiving Space through Phenomenology, Giving Children Space	49
Looking Ahead	51
CHAPTER TWO: LISTENING TO CHILDREN: TELLING THEIR STORIES	52
Establishing a Strong Pedagogical Orientation	53

2) Investigating experience as we live it rather than as we conceptualize it	158
3) Reflecting on the essential themes which characterize the phenomenon	159
4) Describing the phenomenon through the art of writing and rewriting	162
5) Maintaining a strong and oriented pedagogical relation to the phenomenon	165
6) Balancing the research context by considering parts and whole	168
Finding the Right Space and Place: A Description of the School Site and Classroom	170
Description of the School	171
School Vision and Mission Statements	172
Science Related Activities	172
Description of the Student Population	174
The Classroom Layout	176
Overview of the Study in the Inquiry-Based Classroom	178
Standards-Based Curriculum	179
Inquiry-Based Pedagogy	179
Student Writing	180
The Schedule	181
The Conversants in Conversation	183
Classroom Teacher Profile	185
Student Conversant Profiles	185
Former Student Conversant Profiles	196
Looking Ahead	198
CHAPTER FOUR:	
BY THE LIGHT OF THE COSMOS: ILLUMINATING THE INQUIRY-BASED SPACE SCIENCE CLASSROOM	199
Traveling at Light Speed: The Active Inquiry-based Classroom	202
Doing	205
Visualizing	209
Comparing and/or Contrasting	212
Moving	215
Engaging	218
Listening	221
Remembering	222
Focusing the Light	224
Reflecting the Light: The Interactive Inquiry-based Classroom	226
Communicating in the Interactive Classroom	229
Learning to Interact	232

Reflection Leads to Revelation	235
Beyond Right Answers	240
Bouncing Around Ideas	243
Listening, Hearing, and Reflecting	247
Unfiltered Reflection	248
Reflecting the Light	255
The Essential Sun: Lighting the “Inquiractive” Inquiry-based Classroom	257
“Inquiractivity” Introduced	258
Looking Back on Themes	259
Asking	261
From Inquiry to “Inquiractive”	264
Persistent Questions	271
Student Ideas About Inquiry	275
Teacher Ideas About Inquiry	280
Curiosity and Wonder	283
What About Our Questions?	285
Our Source – The Sun	289
From Darkness to Light	292
The Inquiry-based Space Science Classroom	294
Looking Ahead	296
CHAPTER FIVE:	
PASSION WITH COMPASSION: GIVING SPACE AND FINDING SPACE IN THE INQUIRY-BASED CLASSROOM	297
Passion with Compassion	298
Passion for Learning	300
Compassion for Learners	303
Giving Space and Finding Space	306
Permission to Give Children Space	312
Sputnik Moment: Accepting the Challenge	317
The Next Generation of Science Standards	322
From Inquiry to Practices	323
1) Asking Questions	325
2) Developing and Using Models	326
3) Planning and Carrying Out Investigations	327
4) Analyzing and Interpreting Data	328
5) Using Mathematics, Information and Computer Technology, and Computational Thinking	329
6) Constructing Explanations	330
7) Engaging in Argument from Evidence	332
8) Obtaining, Evaluating, and Communicating Information	333

Reflecting on Practices	333
What About the Next Generation of Space Science Content?	335
New Horizons: What Does the Future Hold?	338
Carrying the Message Forward	341
To Boldly Go	342
Going	343
APPENDIX A: I WONDER... BLACKLINE & SAMPLE RESPONSES	346
APPENDIX B: SPACE CURRICULUM: TIME MANAGEMENT GUIDE	348
APPENDIX C: WHAT IS IT LIKE TO PARTICIPATE IN THE SAMOAN CIRCLE?	354
APPENDIX D: WHAT IS THE MEANING OF INQUIRY TO YOU?	356
APPENDIX E: PARENT COVER LETTER	358
APPENDIX F: PARENT CONSENT FORM	360
APPENDIX G: STUDENT ASSENT FORM	367
REFERENCES	371

List of Images

Image 1.1 Chris Horne, 1966, age 5, Halloween	10
Image 1.2 Man's first step on the moon http://starchild.gsfc.nasa.gov/docs/StarChild/space_level2/apollo11_footprint.html	12
Image 2.1 Horne, 2003, Mount Airy, Maryland	67
Image 2.2 Horne, 2004, Mount Airy, Maryland	67
Image 2.3 Horne, 2005, Mount Airy, Maryland	67
Image 2.4 Horne, 2003, photo shared with students in Mrs. V's class	93
Image 3.1 Space Day race, May, 2006	174
Image 4.1 Hubble Deep Field Image Unveils Myriad Galaxies Back to the Beginning of Time http://hubblesite.org/newscenter/archive/releases/1996/01	204
Image 5.1 Sputnik http://www.jpl.nasa.gov/explorer/captions/sputnik.php	317
Image 5.2 New Horizons Pluto Kuiper Belt Flyby http://nssdc.gsfc.nasa.gov/nmc/spacecraftDisplay.do?id=2006-001A	338
Image 5.3 Earthrise at Christmas http://www.nasa.gov/multimedia/imagegallery/image_feature_102.html	345

CHAPTER ONE:

TURNING TO LIFE'S PASSIONS

Why does the moon change the way it looks?

There is something in front of it. (Chad)

God wanted it to. (Senata)

The sunlight hits the moon at different angles. (Charlie)

Because without the moon there wouldn't be heat at night or light.

(Bes)

Because that's how it is. (Katie)

The moon gets covered by the clouds. (Carlos)

(Responses written by students in Mrs. V's 4th grade class, 2004)

Inquiry into Inquiry-Based Science: The Passion Begins

Why *does* the moon change the way it looks? Carlos says it is because the moon gets covered by clouds. There are almost as many different responses as there are students in the 4th grade class. What do these student responses tell me? As a teacher, what steps should I take next? When should I tell the students the right answer? *Should* I tell the students the right answer? Is there a single right answer to this question? What do their answers reveal? I want to know! It is this passionate desire to know, this stream of unanswered questions, this unquenchable desire to learn that prompts my inquiry. I want to know what to say, what to do, what not to say, what not to do! I sense it is my duty as a teacher to guide my students to a means of knowing – a place of knowledge – a way of discovering. In *The Courage to Teach*, Parker Palmer (1998) notes that “Knowing of any sort is relational, animated by a desire to come into a deeper community with what we know...Knowing is a human way to seek relationship and, in the process, to have encounters and exchanges that will inevitably alter us. At its deepest reaches, knowing is always communal” (p. 54). This kind of knowing is not about remembering isolated facts. It is about a connected

kind of knowing that both calls the teacher to be a learner and calls the learners to share what they know. I want to know and I want to know what my students know. I desire the kind of knowing that, as Palmer puts it, “alters us.” In the space science classroom, what does such knowledge look like?

Interestingly, the word science comes from the Latin *scientia* meaning knowledge. The word *scient* is derived from the word *scire* which means know or to know (Onions, 1966, p. 797). As a science teacher, an author of science curricula, and a life-long learner of science concepts, I have a never-ending passion to know. I have pedagogical questions; I have content questions; I have questions to which there are no possible answers. All of my questions are rooted in a passion to know and a desire to spark such a passion within each student I encounter.

As I struggle with the students’ responses to the moon question, I continue to ask myself questions. I wonder. I want to know how I can provide a rich learning environment for my students. I want my students to experience encounters and exchanges that will alter them. And, as a part of something much bigger, I want my students to know why the moon changes the way it looks.

Selecting a Context for My Experience in the Space Science Classroom

Chris Horne is my best friend and one of the best teachers I have ever worked with. He is a science/math facilitator...
(Excerpt from a note from Mrs. V, 4th grade teacher, sent to parents inviting participation for their child in a research project)

Over the past several years, Mrs. V, a teacher and long-time friend and colleague, has welcomed me to share the space science curriculum with her students. As a teacher specialist for multiple elementary schools, I am able to enter the classroom experience as a visiting instructor. Parents have given permission for me to

audio and videotape classroom sessions, as well as to record small group and one-on-one discussions. Approval for my work in Mrs. V's classroom was given through a National Science Foundation Grant (No. ESI-9986846) sponsored by the University of Maryland, College Park and directed by Dr. David Hammer and Dr. Emily van Zee.

My criteria for selecting groups of children in which to engage in active, inquiry-based instruction is based on identifying teachers who support and encourage such an approach and welcome someone, such as myself, into the culture of their classroom. Over the past several years, as part of ongoing research projects, I have taught space science with 4th grade students in eight different classrooms, most recently with Mrs. V's students. She and I have co-taught math and science methods courses for Mount Saint Mary's University since 1998 and hold similar philosophical views regarding instruction. We have developed an abiding professional trust, which allows me to enter the classroom as a welcomed guest and friend. I have a very positive long-term professional relationship with the school's principal, and have been welcomed into the school community with open arms. The support of the school administration and classroom teacher has been crucial. With their blessing and support, I was able to establish myself within the classroom environment from the beginning of the school year.

Having a school and classroom community that is warm, welcoming, and trusting is essential to hear students' hearts regarding their space science experiences. My goal is to avoid being seen as an outsider coming in to "study" the behavior of

cold distant subjects. Instead, I enter the school and community as a welcomed part of what is taking place – a Being-in-the-world with the school community.

Inquiry-Based Science as a Context for Student Experience

A prominent feature of the *Standards* is a focus on inquiry. (National Research Council, 2000, p. xv)

No doubt, inquiry and inquiry-based science are hot topics in elementary science education circles. Simply refer to *Science and Children*, NSTA's (National Science Teachers Association) peer-reviewed journal for elementary teachers, and you will find repeated references to inquiry and a deliberate effort to connect each article with the *National Science Education Standards*. Many years in the field of science education have led me to conclude that inquiry-based science is a powerful means to provide effective learning experiences to children. Few in the field of science education would challenge this notion. The National Research Council (2000) states:

If one accepts the full sweep of content in the *National Science Education Standards*, including conceptual understanding of science principles, comprehension of the nature of scientific inquiry, development of the abilities for inquiry, and a grasp of applications of science knowledge to societal and personal issues, the body of research clearly suggests that teaching through inquiry is effective. (p. 126)

My inquiry, however, is not focused on the determined effectiveness of inquiry.

Rather, I am curious to explore what the experience is like as my students learn science through inquiry. Whether or not the strategy is determined effective, what is inquiry-based science like for the child? Regardless of how students score on assessments, what was the lived meaning of the experience? Irrespective of

curriculum theory, what do the children experience? I desire to know, so I continue to ask questions.

Using Curriculum as a Context for Student Experience

My inquiry into the lived meaning of student inquiry is founded on the stated objectives of the local and state curriculum. Without such a context, I am merely following my own instincts, rather than trusting in the standards and objectives developed over time by a host of skilled educators. The standards guide *what* is taught in a standards-based era; however, an inquiry-based approach can guide *how* children learn. So I ask, what does the curriculum say about the content knowledge expected of my 4th graders? Should my students be expected to observe and recognize the changing pattern of the moon that occurs over time? The *Maryland State Curriculum* (2008), based largely on the *Benchmarks* (American Association for the Advancement of Science, 1993) and the *National Science Education Standards* (National Research Council, 1996), says students should:

Recognize and describe the causes of the repeating patterns in celestial events. (Indicator: Grade 5, 2.D.2, p. 10 of 36)

A study of the moon and its changing pattern is inferred here, but not explicitly stated. A study of the day/night pattern would be another way to meet the learning objectives of the previously stated indicator. The following Maryland State Curriculum indicator is more explicit regarding a need for an inquiry of the moon:

Verify with models and cite evidence that the moon's apparent shape and position change. (2008, Indicator: Grade 5, 2.D.2.e, p. 10 of 36)

In light of the student responses I collected regarding the moon, these indicators suggest we have work to do. The students have many ideas about the changing moon.

Some of their thinking is “scientifically accurate,” some is not. “Correct” or not, if I am to use an inquiry approach, I must respond to their answers, not out of fear of what they do not “know,” but with enthusiasm for what they might discover. The *Maryland State Curriculum* (2008) states:

From their very first day of school, students should be actively engaged in learning to view the world scientifically. That means encouraging them to ask questions about nature and to seek answers, collect things, count and measure things, make and record qualitative observations using simple diagrams, illustrations, and oral or written language, organize collections and observations, discuss findings, etc. Getting into the spirit of science and liking science are what count most. (p. 1 of 36)

The language of the curriculum invites us to a way of knowing that moves beyond simply verifying facts or citing evidence to support answers. Yes, that is a part of science, but the curriculum asks us to do so much more. In fact, it requires we do so. Embedded in the curriculum is a challenge to engage students in such a way as to get them into the “spirit” of science – to “like” science. This is no small directive!

How is a teacher to accomplish such a significant task? The curriculum gives further detail regarding concepts that are to be covered (or uncovered). The written responses submitted by the students provide insight into the children’s current understanding. But *how* should this material be taught? More importantly, how should it be *learned*? Can I just tell the students why the moon changes the way it looks? Will they remember what I tell them? Would it be better to show them? How might that help? Will I be able to capture the “spirit” of science? Will they come to “like” science? As I engage in the process of teaching and learning, I continue to question.

Looking Deeper into the Meaning of Inquiry

I have decided to use the established space science curriculum as a guide for instruction and inquiry-based science as a pedagogical framework in my inquiry into the lived experience of students in the space science classroom. To make sense of children's experiences in an inquiry-based science classroom, a closer look at the term is necessary. The *National Science Education Standards* document (National Research Council, 1996) states:

Inquiry into authentic questions generated from student experiences is the central strategy for teaching science. Teachers focus inquiry predominantly on real phenomena, in classrooms, outdoors, or in laboratory settings, where students are given investigations or guided toward fashioning investigations that are demanding but within their capabilities. (p. 31)

Inquiry is a critical component of a science program at all grade levels and in every domain of science, and designers of curricula and programs must be sure that the approach to content, as well as the teaching and assessment strategies, reflect the acquisition of scientific understanding through inquiry. Students then will learn science in a way that reflects how science actually works. (p. 214)

In the first statement, inquiry is referred to as the “central strategy for teaching science,” and in the next statement it is said to be a “critical component.” These quotes and numerous others from the *Standards* (National Research Council, 1996) refer to inquiry as the essential means by which I should guide my students. But, what is the meaning of inquiry? According to *Webster's Encyclopedic Unabridged Dictionary of the English Language* (2001), inquiry is a “seeking or quest for truth, information, or knowledge” (p. 985). *The National Science Education Standards* (National Research Council, 1996) define it this way:

Inquiry is a set of interrelated processes by which scientists and students pose questions about the natural world and investigate

phenomena; in doing so, students acquire knowledge and develop rich understanding of concepts, principles, models, and theories. (p. 214)

Inquiry simply is seeking through questioning. To inquire is to question. Gadamer (1960/1989) says that questioning "...is more a passion than an action. A question presses itself on us; we can no longer avoid it and persist in our accustomed opinion" (p. 366).

In my role as a science teacher, my mind continuously races with questions. They press upon me. I question because I want the students to learn, to understand, to grow, to become better thinkers, to love learning, and to find their passions. I am using an inquiry-based approach because I believe it is a powerful way to instruct – and even more importantly, a powerful way to encourage children to learn. I rely on the curriculum because I believe it will serve as a trustworthy guide. As a teacher-researcher, I return to the questions my inquiry presses upon me: "What is the experience like for the students? What will they come to know in this setting? What questions press upon them? What is the lived experience of students during a space science inquiry?" As I begin this inquiry into inquiry-based science, I realize I must be driven by my passions, for without them, I could easily lose my way.

Living My Passions

Whoever teaches learns in the act of teaching, and whoever learns teaches in the act of learning. (Freire, 1998, p. 35)

A Passion to Tell my Story

Teaching is difficult! The realization of this simple truth came after much experience and reflection. In *What is Called Thinking?* Heidegger (1968) says, "Teaching is more difficult than learning. We know that; but we rarely think about it"

(p. 15). Exactly! I used to think teaching was easy and, if I thought about it at all, learning was an assumed result of good teaching. Early in my career, I focused energy and attention almost solely on the act of teaching, defined in my mind as a dynamic sharing or telling of information. I did not stop to consider the critical role of learning *in* the art of teaching. After spending many years with children in 4th grade space science classrooms, listening closely to their discourse, and scrutinizing their writing, I have become more cautious in my proclamations. I used to say, “*Teaching* is easy, once you know how.” I believed my style of teaching engaged children, causing them to learn. I believed I had the teaching skills necessary to develop understanding in the inquiring young minds I was attempting to reach. I believed my passion for teaching and love of science was all that was needed for learning. And perhaps some of what I believed had validity, but fundamentally, I failed to see the powerful interplay between teaching and learning. I was giving too much credence to the act of teaching, the transfer of facts, without recognizing the enormous power of learning through inquiry. The previously cited quote by Heidegger (1968) continues:

And why is teaching more difficult than learning? Not because the teacher must have a larger store of information, and have it always ready. Teaching is more difficult than learning because what teaching calls for is this: to let learn. The real teacher, in fact, lets nothing else be learned than – learning. . . . The teacher is ahead of his apprentices in this alone, that he has still more to learn than they – he has to learn to let them learn. (p. 15)

The focus is on student learning, not on the teacher, or the act of teaching. The message is clear and it is central: I must learn to let the children learn even if it is difficult. Letting children learn is foundational to the story of every effective classroom.

What I am learning about children and learning about myself as a teacher is at the heart of the story I have to tell. This is the story of an eager teacher, passionate about space, and passionate about teaching, discovering with eager learners that the role of teacher and learner can be shared. As a curious teacher, I am discovering that inquiry-based teaching leads to more questions than answers, and I am recognizing children's central role in the inquiry process. As an inquiring teacher, I wonder and never stop wondering as the students wonder along with me. But to tell the story, to tell *our* story, I will have to take you back – back to a time long before I ever considered the possibility that a 4th grader like Carlos, taught by a determined teacher, would still think that the moon changes the way it looks because “the moon gets covered by the clouds.”

A Passion for Space – Looking Up

The scientist does not randomly choose a specific discipline or specialty, but is drawn to a particular field by a complex of subjective experiences and encounters, many of which unfold far from the laboratory and its rarefied atmosphere. (Abram, 1996, p. 33)



(Image 1.1 Chris Horne, 1966, age 5, Halloween)

My “wonderings” about space are not new. My first decade of life coincided with the post Sputnik “space race.” Caught up in President Kennedy’s challenge to reach the moon by the end of the decade, by the age of five I already knew I wanted to be an astronaut. I wanted to explore space and go to the moon. As I grew up, I became fascinated by the night sky. I spent hours as a boy playing outdoors with my neighborhood friends, especially during the long days and care-free nights of summer. After dark, we would lay out on the ground or on the hood of some car staring upwards and talking about what we saw and what we wondered. After awhile, the moms would holler for us to come in. Somehow that was okay; we knew we would do it all again the next day.

My childhood home was equipped with butterfly nets, telescopes, rocket models, books on space, and magazines like *Nature*, *Astronomy*, and *Sky & Telescope*. Dad was the source of all this paraphernalia, evidence of his obsession with anything science related, especially the study of space. For all his interest though, I do not recall him ever lecturing on facts. He never tried to teach the neighborhood kids or me to remember the names of certain stars or constellations or to identify how many planets there are. Instead, Dad led by example. Together, we searched for bugs and lichens by day and scanned the night sky for objects of interest by night. Dad’s way of teaching was not by telling, but rather by doing; by showing; by wondering. His enthusiasm was contagious!

Though he never seemed to force the issue of showing an interest in science, Dad made me stay up until way past my bedtime on one particular summer night. The date was July 20, 1969. I was just 8 years old. All I wanted to do was go to sleep, but

he insisted I stay up to watch the first human set foot on the moon. It was on live television – a chance of a lifetime!



(Image 1.2

http://starchild.gsfc.nasa.gov/docs/StarChild/space_level2/apollo11_footprint.html)

Once that fateful first step was taken, I was off to bed, not realizing how important it was for me to observe such an event or how glad I would be that I had seen it! Now, in retrospect I ask, just how important was that event? How did it affect me then? How does it affect me now? Did the national attention to the moon landing help to shape my interests as a young child? Did it help shape my decisions about the future?

And what about the students sitting before me in the space science classroom today? How will the events taking place in space now affect their developing young minds? How might the privatization of space travel impact their future? Will the *New Horizons* mission scheduled to reach Pluto by 2015 bring news that changes the trajectory of their lives? Answers to such questions are not clear, but such wondering sparks possibility, encourages dreams, incites hope.

A Passion for Space – Stepping Out, Finding Hope

What does it mean to listen to a voice before it is spoken? It means making space for the other, being aware of the other, paying attention to the other, honoring the other. It means not rushing to fill our

students' silences with fearful speech of our own and not trying to coerce them into saying things that we want to hear. It means entering empathetically into the student's world so that he or she perceives you as someone who has the promise of being able to hear another person's truth. (Palmer, 1998, p. 46)

Very quiet.

Sometimes silent.

Often listening.

These words reflect my early memories of walks in the woods with my Dad.

Looking back brings to mind fond recollections of endless shady trails, cool meandering creeks, and majestic towering trees. Quite often, few words were spoken. Words did not always seem necessary, somehow. I wonder about that now. The silence never seemed awkward. The forest seemed to have voice enough for both of us. I felt connected to Dad with no need to chatter on and on. I was not afraid to speak; I simply had nothing to say. Dad seemed to respect that. He modeled the same. But all of our time together was not silent. If words were needed, they were spoken, without hesitancy.

Though the experiences could be called walks or hikes, to me they were more like adventures, mysterious explorations, hunts, or perhaps just an opportunity for looking – we were always looking here and there for something. Only what we were looking for was not clearly defined. I suppose Dad might say we were just looking for “cool stuff.” Or maybe it was not a looking *for* at all, but rather just a looking *at* – a lived experience with no explicit motive – informal learning at its essence.

“Look at this Dad, what is it?” I would ask! “I’m not sure” he might say, “but it’s a keeper.” As we would walk along (or as I would run ahead!), things would

catch my attention. Whatever I might find interesting Dad met with equal enthusiasm. And he would find interesting things too, and point them out. He showed me how to roll back a rotting log to discover “things” that might be lurking beneath. He took time to show off the “stuff” he had enthusiastically gathered. In retrospect, he was acting, in many ways, like a kid – spontaneous, playful, unpretentious. I do not remember noticing it then. To me, Dad was just being Dad.

Out in the woods I had a sense of space – a sense of spaciousness. It was a space to learn, a space to wonder, a space to ask without needing an answer, and a space to discover. It was a space for hope, I think. But, while I reflect on my childhood experience of space, I wonder, “What is the lived experience of hope for the children I teach?” Hope looks forward. Hope anticipates a future that is good – even better than today. Hope imagines possibilities. Hope dreams.

Lucy Sprague Mitchell, founder of the famous Bank Street School, a progressive college of education, once wrote:

We believe that the purpose of education is to help students develop a scientific attitude of eager, alert observation; a constant questioning of old procedures in the light of new observations; and a use of the world as well as books and source materials... Thus, the most fundamental clause of my personal and institutional credo is: While we are learning, there is hope. (Lucy Sprague Mitchell, as cited in Darling-Hammond & MacDonald, 2000, p. 89)

These powerful words reveal Lucy Sprague Mitchell’s passion. When she says, “While *we* are learning, there is hope,” I cannot help but wonder if her use of “we” refers not only to the Bank Street pre-service teachers and faculty but also to the children who are under their care. Is the experience of hope shared? How do children experience hope through their learning experiences? Does space give rise to hope?

How are learning and teaching, hope and space connected? Can a teacher encourage hope in children? Can a child encourage hope in teachers?

Mattie Stepanek's book, *Hope Through Heartsongs*, offers light. At age 10

Mattie writes:

Life is like a story book...
Although we aren't
Able to talk with
Dragons and fly far into space,
Each day is like
A new chapter,
With new lessons
For our lives.
Life is like a dream...
Although we don't
Know what kind of
Reverie we will have,
Each day is like
A new thought,
With new hopes
For our lives.
(Stepanek, 2002a, p. 54)

The words of this young author cry out to my heart. "Each day is like a new chance...a new chapter...a new thought...new hopes" – He has captured the essence of hope.

In our fast-paced culture that has an insatiable craving for results on standardized tests, many classroom teachers and students seem to lack hope. I see a hopelessness growing in the shrinking space. Even so, I maintain hope for the children who experience the elementary space science classroom. I hold hope for a space where we, as teacher and student, together, can find hope; a space where we, together, as student and teacher, can teach one another; a space where we, together, as

teachers and learners, transform Heidegger's (1968) call "...to let them learn" (p. 15) from an idea to a lived experience.

A Space for Hope

From a classroom down the hall
I hear, "Quiet! Quiet down!"
But...
Is there a space for quiet?

I hear, "Silence! Be silent!"
But...
Is there a space for silence?
I hear, "Listen! Listen up!"
But...
Is there a space for listening?

I hear, "I hope so! You better hope not!"
But...
Is there a space for hope?

Quiet space...

Silent space...

Listening space...

The classroom down the hall...
A Space for hope!
(Horne, 2005, reflective writing)

As a child in the woods I never considered the passage of time. I did not feel pressed to quickly find out, to come to final conclusions. I was experiencing the space and enjoying my time. It could be described as "time standing still," an experience where the passage of time is not even recognized. Can this childhood experience in the woods reveal anything about the lived experience of children engaged in a space science inquiry? Can a classroom experience engender feelings of space, of timelessness, of hope? What do students experience in the classroom as they are

given space? What is the lived experience of children engaged in inquiry-based science?

A Passion for Teaching

Good teachers possess a capacity for connectedness. They are able to weave a complex web of connections among themselves, their subjects, and their students so that students can learn to weave a world for themselves. (Palmer, 1998, p. 11)

I was a freshman in college when I first recognized that I had a gift for working with young children. Experiences as a camp counselor and later placements in local elementary schools reinforced my beliefs that I had found a “niche.”

Observers, cooperating teachers, and my own reflections confirmed that I had found the “right” field when I selected elementary education as a major. Over and over, I was told I was a “natural” teacher. But, what exactly did they mean by “natural?”

Webster’s New World Dictionary (2001) defines natural as “innate; not acquired” (p. 959). Certainly I was not born with the skills to teach. What were they seeing in me? Where did this ability to teach come from? What does it mean, “to teach?”

At the age of 20, prior to my student teaching experience in the fall of 1982, I completed an information sheet for my supervisor that included a statement of goals.

I wrote:

My goal as a teacher is to continue to learn. I believe no one can know everything there is to know about teaching. I have heard of many teachers who fall into a rut and continue to do things the same way over and over. They don’t allow new ideas or concepts to enter their classroom. I want to be able to offer the children new experiences and try new ideas to see if they work better than the old ones. (Horne, 1982, from a statement of goals for student teaching)

Even at the outset of my teaching career, my love for science blended nicely with my passion for engaging children in a love for learning. Through student teaching and

during my early career as an elementary school teacher, I came to be known by other teachers as a helpful and knowledgeable resource for science teaching ideas. When I was hired to co-teach a 2nd grade class in a low achieving school, it was no surprise that I was given the task of teaching science. My love for science and science teaching grew and so did my confidence. The young students loved to explore, to wonder, and to ask; and I was happy to facilitate their enthusiasm and to grow along with them.

After 9 years in the classroom, my love for children, my deep interest in teaching and learning, and my passion for science miraculously aligned when I became an elementary school teacher specialist for science and math. When I first heard about the new position during an otherwise boring faculty meeting, I could not believe my ears! The rest of the faculty, for that matter, the rest of the world, became a blur in the background. Time ceased as my mind raced with all the possibilities. I was suddenly filled with new hope, for the role of teacher specialist would call for all of the passions and interests my career had come to define. After the faculty meeting, I nervously rushed to meet my principal, worried that she would not share my excitement. I was thrilled to discover quite the opposite was true. She was fully supportive of my intentions and throughout the months ahead, diligently worked on my behalf to prepare me for the road ahead. Though I was not sure I had all of the qualifications necessary for the position, my principal assured me that what I lacked in experience I made up for with passion.

A Passion for Change

To grow is to change and to be perfect is to have changed often.
(John Henry Newman, as cited in O'Donohue, 1997, p. 128)

My role as a teacher specialist allowed me to work with children in numerous schools, participate in science and math events throughout the district in which I work, provide professional development for teachers, and work closely with others to develop and modify curriculum. An interaction with a student during a county science fair became the impetus for changes to my thinking and to our district's space science curriculum.

On a Saturday morning in March, elementary-age students from around the county arrived at a high school to present their science fair projects to a team of judges. The students, grades kindergarten through 5th, entered the gymnasium at their designated time and stood by their projects with nervous anticipation, waiting for the judges to quiz them about their work.

After judging the county fair for many years, I enthusiastically anticipate this experience! I love to sit with the children to ask them about their work, their thinking, and their love for science. Just as the morning activities were getting underway, I approached a young student, attracted to her project because of the obvious space theme. The display board had been painted black and it was decorated with what appeared to be glow-in-the-dark stickers, each 5-point star shapes. I started my conversation with a simple introduction followed by chit-chat intended to put the young student at ease. She seemed comfortable with me from the start and was quite enthusiastic about her project. I do not recall the grade level of the student, but I am sure she was rather young, likely in first grade. As a way of beginning my questioning, I pointed out the "star shaped" stars on her display board and asked, "How do the star stickers on your display compare to the stars you actually see in the

night sky?” This question puzzled her. She looked at me and said quite plainly, “I don’t know, I’ve never really looked at the stars in the sky!” This response surprised me. I was expecting to discuss the comparison between her actual experiences as she views the night sky and the traditional star shaped pictures on her display. Her mother, waiting nearby against the folded bleachers, darted over to intervene. “Oh, we have a lot of bright lights in our neighborhood! I will take her out tonight and show her some stars.” This interruption, too, was quite unanticipated. After I assured the mom that everything was quite all right, she returned to her spot against the bleachers and I resumed my discussion with the student.

She was very knowledgeable of space related ideas; she knew the names of the planets, and seemed to be fascinated by the topic. I concluded my time with this young student by praising her for the beautiful display of stars and planets, and encouraging her to continue exploring her love for space and science. Finally, I reminded her of the wonder of the night sky and suggested she and her mom go out on a clear night and observe its beauty.

The impact of this experience on my thinking was profound. I wondered, “Why had this enthusiastic student never looked up into the night sky? How could someone so young have an apparent interest in space without any significant direct experience? What does this say about the methods we use to teach space science in the elementary schools? What can I do to make a change?”

My passions were sparked by this encounter. The fire she started led us to look more closely at our curricular resources. The efforts of many teachers and curriculum developers eventually produced a revised space science curriculum in 2nd

and 4th grades within my school district. The curricular resources now explicitly asks students to look up – and to wonder!

A Passion for Learning

I consider myself a lifelong learner. I have thrived on my interactions with colleagues and professors throughout my pursuit of master's degrees from both Western Maryland College and Hood College... Through my experiences thus far, I have discovered that my greatest love and most compelling interest is to better understand how young children learn. As a result, I am determined to maintain contact with students in the elementary classroom as well as commit myself to studying current research. (Horne, 1999, from Statement of Goals on a graduate application to the University of Maryland, College Park)

In the fall of 1999, I started my first semester as a doctoral student in science education at the University of Maryland. Dr. Emily van Zee was both my advisor and my first professor. The first night of class Dr. van Zee challenged us to write what we understood about inquiry-based science. On a handout she posed the following question:

“How would you define ‘inquiry approaches’ to learning and teaching?” In response,

I wrote:

Students learn by doing. Students are actively involved in the hands-on manipulation of materials in order to construct meaning through their experiences and follow-up discussions relative to the experience. (Horne, September 7, 1999, from class notes, EDCI 670, Trends in School Curriculum)

About 10 weeks into the semester Dr. van Zee asked the class to respond in writing to the same question posed the first night of class. I wrote:

Inquiring minds want to know. Inquiry is about “wonder.” Asking questions and seeking to find those answers through scientific investigations, observations, discussions. Inquiry is hands-on and brains-on. (Horne, November 16, 1999, from notes, EDCI 670, Trends in School Curriculum)

In my graduate application I stated that, "... my greatest love and most compelling interest is to better understand how young children learn." From the first night of doctoral studies, and throughout the semester I was challenged to consider this very issue. Reflectively, I asked, how do young children learn? Is it through a hands-on experience? Is inquiry-based science central to facilitating learning? Is my method of teaching aligned with inquiry-based science? What exactly is inquiry-based science? Could the inquiry-based approach be the answer to my question?

Later in the semester, as a result of an assignment given by Dr. van Zee, I wrote an article that was published in the Maryland Association of Science Teacher's periodical, *The MAST Rapper*. The article, *Using Moon Models: Is "Hands-On" Really Enough?* serves as a documentation of my thinking at that time. In the article I state:

The teachers tell me, "My kids just aren't getting it!" Of course they aren't! We are asking the students to transfer a vague recollection about the moon and its changing appearance to a simulated observation in a classroom. The "hands-on" activity has little or no connection to the students' actual experiences. (Horne, 1999, p. 16)

Through study, reading, and professional writing I was quickly grasping the very thing I had sought after: "...to better understand how young children learn." I believed that children needed to experience the world, the real world, in order to begin to understand it; hands-on science alone was not enough. I believed that students needed to make careful observations of the earth, sun, and moon if they were to make scientifically accurate statements regarding their motions and properties. I believed students needed to collect and analyze meaningful and relevant data as part of the learning process. I believed I had developed a firm grasp of inquiry-based

science and how to implement such an approach in the 4th grade classroom. I believed I had a viable plan to give the students the experiences they needed in order to learn space science concepts in a meaningful way!

I was confident. I had knowledge. I even had the best interests of children in mind. I had passion, I had enthusiasm, and I was on my way to developing and implementing a research study – a study that would show, through analysis of pre and post data, that my form of inquiry-based science would “work.” In my thinking, the research was a formality (such arrogance!). I already knew the results would show statistical significance. Now I just needed to conduct the study, an analysis of 4th grade students’ understanding of space science concepts before and after “treatment.”

But now, as I look back and reflect on my beliefs and attitudes, I begin to ask questions: Was my knowledge, my confidence, my passion, and my enthusiasm enough to allow me to understand better how children learn? Did I lack the patience to wait for insights to present themselves? Was I in such a hurry to prove what I thought I already knew, that I would compromise my desire to do what is right for children, even if it meant a change of direction? Did impatience get the best of me? Patience is defined as “an endurance with calmness” (Onions, 1966, p. 657) and is rooted in the word *pati* – to suffer. The early meaning of patient is “to suffer or endure without complaint” (Onions, 1966, p. 657). Ironically both patience and patient are closely related to passion. So, my passion, my willingness to “suffer” for the sake of making a good decision pedagogically, my willingness to endure in order to find insight, stood in conflict with my impatience, my unwillingness to endure

suffering, my fear that I needed answers right away, my arrogance, which closed my ears to hear and consider other perspectives.

Not long into my study, I experienced a conflict that became a critical turning point in my thinking and ultimately led to a dramatic change in my research focus. In my study design, I posed three questions to which participants would respond in writing: Why does it get dark at night? Why does the moon change the way it looks? and Why is it warmer in the summer and colder in the winter here in Maryland? The questions were posed to 117 students in the 4th grade, including 27 students in my “treatment” group as well as 90 students from three other 4th grade classes within the same school. I looked for differences between the classes I taught (the treatment group) and the comparison groups by posing the same three questions to the children after they completed their space science units. I also planned to give the same test to the students in the fall of the upcoming school year to analyze retention of concepts learned during the science units.

The pre-treatment data were impressive – and, in a way, convicting. It struck me that the children’s responses were not something I could merely tuck away until after I completed the space science unit. I felt great conviction that the thinking they poured onto the pages of the pre-treatment assessment needed to serve a greater purpose than merely pre-intervention data for my study. In my final project submitted to Dr. van Zee at the end of the semester I stated:

I have also decided that it will be valuable for the class to review their pre-test responses from September when I meet with them in January. They will have an opportunity to compare their new thinking to their pre-test responses and share their thoughts with each other in small groups and as a total class. It is possible I will invalidate the results of my project by engaging them in conversations about their responses to

the test questions. I have come to believe, however, that an important component of the space science unit is for the students to have opportunities to share and discuss their conceptions and communicate their thinking as new information influences their ideas. (Horne, December, 1999, from final project for EDCI 670, Trends in School Curriculum)

I was torn. Increasingly, I was coming to believe that inquiry-based science was far more than just believing “Students learn by doing” as I stated on the September 7, 1999 assignment. But the question of what constitutes good research still plagued me.

The spring semester brought new challenges and I continued in a mode of probing and reflection. In EDCI 671, Dr. McGinnis allowed me to continue my study with 4th grade children in the space science classroom. The project led to a presentation at the National Science Teachers Association (NSTA) conference in November of 2000.

Eventually, conviction would override concerns regarding research design. As time passed, and through ongoing reflection, I started to discover the intense power of allowing children to reflect on their own thinking. I was shifting, subtly, slowly, from believing that what I say and do in the classroom is of primary importance, to realizing it is what children say and think that must become equally important if true learning is to take place.

I found the learning experience through the first year of doctoral studies both meaningful and humbling. Humbling in this sense was different from the image of one walking about with their head hung low. Rick Warren (2002) says, “Humility is not thinking less of yourself; it is thinking of yourself less. Humility is thinking more of others. Humble people are so focused on serving others, they don’t think of

themselves” (p. 148). C.S. Lewis (1952/1996) describes humility in terms quite different than the convention:

...Do not imagine that if you meet a really humble man he will be what most people call “humble” nowadays: he will not be a sort of...person who is always telling you that, of course, he is nobody. Probably all you will think about him is that he seemed a cheerful, intelligent chap who took a real interest in what *you* said to *him*. (p. 114)

I am learning humility, learning to take a genuine interest in what children think and say. I am learning to think of self less and children more, learning to combine passion with humility – and I am coming to realize this as a powerful combination.

A Passion to Research

Education does not make us educable. It is our awareness of being unfinished that makes us educable. (Freire, 1998, p. 58)

I was angry! Angry and frustrated! Dr. Hammer kept telling me to “listen” to the kids. I thought I *was* listening! He would say, “Pay particular attention to what they are saying and don’t worry so much about what the teacher is doing.” “I am!!” I thought! “But the teacher’s actions and words are important too!” After the completion of my first year of doctoral studies, a National Science Foundation grant provided a golden opportunity to find answers to the myriad of questions that troubled me as I continued to transform from a more teacher-centered paradigm of instruction to a more student-centered view of learning. Things were *not* going as I had once envisioned. We would videotape our science classes, transcribe the lessons, and then discuss them together in class.

At the time I did not realize it, but I was learning patience. I was learning to listen, listen closely, to the voices of children. I was learning to tune out other

distractions and focus on the thinking expressed through the words of my young students. I was learning to keep quiet during instruction. I was learning to do what my former advisor, Dr. Emily van Zee, calls “practicing random acts of silence.”

Throughout my years of graduate studies Dr. van Zee modeled a practice she termed listening appreciatively (van Zee, 2001). As she describes it, “I listen – and mean it.” Listening appreciatively is practicing silence while staying closely attuned to the flow and direction of the classroom conversation. Van Zee also promoted and modeled another powerful instructional practice she calls spontaneous student-generated inquiry (van Zee, 2001). In this practice, the instructor is attuned to the fact that students are capable of powerful and meaningful dialogue without teacher input. The teacher, acting more as a facilitator, encourages an atmosphere of focused discussion without unnecessary teacher interruption. The term “spontaneous” describes the open, dynamic nature of the dialogue, where students are comfortable interacting with one another and do not feel the need or compulsion to repeatedly look toward and respond directly to the teacher. Spontaneous student-generated inquiry is a practice similar to Heidegger’s (1968) notion of teaching described as “to let them learn” (p. 15).

These practices became lived experiences for me during my graduate studies, and also for my students, as active listening on my part gave rise to spontaneous student-generated inquiry in the classroom setting. Thanks to Dr. van Zee’s influence I was changing – slowly changing. I was beginning to let go of what I thought I knew and allow the children to teach me. I was beginning to let go of my own pedagogical interests and investing efforts toward discovering the learning needs and interests of the children. Again, I was learning humility. Aptly stated, van Manen writes, “The

experience of being a teacher manifests itself in having children on one's mind and wondering what one may expect to become of them" (2003, p. 57).

All along I had attempted to give children space, that is, give them space "concepts." Without realizing it, subtly, slowly, I was giving them another kind of space: space to discuss, space to share, space to wonder, space to question. And, in return, the students offered me a gift, a gift I was not anticipating. They were revealing self. They were offering personal insight. They were sharing space.

At the time, I was not recognizing all that I did not yet know or what I had not yet become. It was not possible to discern what I lacked within. As my story unfolds, I see that it is about becoming what I was not. It is about becoming a teacher, a learner, a researcher. It is about being forever unfinished, accepting what I have become and striving for what I might become. It is about living with an attitude of hope and passing that attitude on to the children I meet, while allowing them to share their own lives and their own hopes. It is about asking questions and seeking answers that lead to still more questions.

Once again, there is no such thing as teaching without research and research without teaching. One inhabits the body of the other. As I teach, I continue to search and re-search. I teach because I search, because I question, and because I submit myself to questioning. I research because I notice things, take cognizance of them. And in so doing, I intervene. And intervening, I educate and educate myself. I do research so as to know what I do not yet know and to communicate and proclaim what I discover. (Freire, 1998, p. 35)

A Passion for Phenomenology

I was now in the 5th year of my doctoral studies, continuing my work with 4th graders in space science classrooms, collecting student work, videotaping lessons, and transcribing dialogue for case studies. I was living my passion as the children

were living their school experience. But still, something was missing. Along with my graduate school colleagues, I analyzed transcripts of videotaped lessons and interpreted classroom interactions. The insights I discovered were exciting, but still, I wondered how I would apply the insights gained.

As part of his research course, Dr. van Sledright required that we conduct student interviews. This experience was a first for me, opening a whole new world of possibility. The process revealed to me children's thoughts and attitudes largely missing in a majority of the research literature I had seen. The insights gleaned from the honesty, openness, and caring exhibited by the children were insightful, but difficult to express in my own research. Following these interviews, I reflected on the process and wrote:

I wanted to get to know the students better. That happened. I did two interviews. Now I am excited to do more. I felt awkward because I know I didn't know how to ask questions in a non-judgmental way. I wanted to draw the interviewee "out." I don't think I did a good job with that. I did "learn" from them. I have many more questions but I did get some answers. I wanted to know where they got their science "facts." I wanted to find out how they liked my way of doing science. I heard that. From Tyrone I got to hear some of his questions, particularly about space travel. Brandy said she liked the lessons "because they get to share what they think." She pointed out how it was different. Awesome. I was looking for that. I was hoping for that. (Horne, October 31, 2002, from interview reflection)

With these interviews came an epiphany! I knew what I had to do, but I had no idea how to do it. How could I reveal the students' perspectives in and through my research? How could I find the means to tell *their* stories? How could I truly inform educators concerning inquiry-based science without allowing the children's voices to be heard? The answers came a few semesters later in the form of EDPL 735, Phenomenological Inquiry I, and in the person of Dr. Francine Hultgren.

After the first night of class, I knew that I had found something unique to my experience, something magical. In my reflection of the first class I wrote:

As the remaining participants shared, I caught myself smiling widely. I found that interesting! Something special had occurred during the hour or so of sharing. I truly felt connected with the group. I was already regretting the fact that I would have to miss class the following week, not because I would miss work and have to make it up, but because I was interested in spending more time with this interesting group of people. (Horne, February 11, 2004, from reflection of class #1)

The weeks ahead proved to be equally exciting. Dr. Hultgren introduced me to phenomenology which provided a way for me to tell the story I knew I needed to share.

Phenomenological research is the study of lived experience. Van Manen (2003, p. 9) says, “Phenomenology aims at gaining a deeper understanding of the nature or meaning of our everyday experiences. Phenomenology asks, ‘What is this or that kind of experience like?’” I desire to find the deeper meanings. I am ready to seek answers. But first, I must discover, or rather, uncover the essential questions.

A Passion to Question

The art of questioning is the art of questioning even further – i.e., the art of thinking. It is called a dialectic because it is the art of conducting a real dialogue. (Gadamer, 1960/1989, p. 367)

My passions drive me to wonder, to ask questions, to seek understanding. I am ready to listen to the students, to reveal their insights, to attempt to discern the essential in what they share. Van Manen (2003) writes:

Regardless of the teacher’s intention, the pedagogically important questions are always: “What is this situation or action like for the child?” “What is good and what is not good for this child?” (p. 145)

What is the essence of their experience – of my experience? What is it like to experience inquiry teaching and learning? Is it good for the child? What insights can be drawn from their lived experiences?

I want to give children space. But is it mine to give? What kind of space do they need? Can I give them the kind of space I received as a child? I continue to wonder:

How can I provide opportunities for listening and hearing about space?
How can I provide opportunities that give space for listening and hearing?
What is the meaning of "listening and hearing" for a child?

How can I inspire learners to seek dreams of space exploration?
How can I inspire learners to seek space for exploration of dreams?
What is the meaning of "dreams" for a nine or ten-year-old?

How can I give learners their own passion about space?
How can I give space for learners to discover their own passion?
What is the meaning of "passion" to a young student?

What is it like for the child to experience space?
What is it like for the child to experience inquiry-based science?
What is it like for the child to experience teaching and learning?

I desire to know. I seek to understand. I am called by the questions. The many questions can be probed through the essential question: **What is the lived experience of 4th grade students engaged in the process of space science inquiry?** To explore this question further, I turn from my passions and look to the passions of others.

Connecting with the Passionate

She opened up a book of poems
And handed it to me
Written by an Italian poet
From the 13th century.
Every one of the words rang true
And glowed like burning coal
Pouring off of every page
Like it was written in my soul

From me to you...
(Dylan, 1975, Tangled up in Blue from the album *Blood on the Tracks*)

Life experiences are filled with texts – words – sound bytes – sermons – speeches – songs – sales pitches. Many words go unheard or unnoticed, but there are times when the words of others penetrate our minds and reach deeply into our soul. It seems that in such times, when words “glow like burning coal,” that we experience the impact of others’ most powerful passions.

The Passion of an Educator

It seemed at first to be yet another reading assignment. How else was I to think of it? Just another of the numerous books on the syllabus; an assigned text; more work. In the endless rows of shelves in the bookstore I found what I had come for. “At least it is short!” I thought, “And paperback, good, it should be cheaper!” I was lucky! I found a used copy, which meant a small savings on a book that I would likely skim, then never see or remember again. The title held no meaning. The author? Never heard of him!

When the time came to read the monograph, I dug it from the bottom of my backpack. It would be my weekend homework. As I began to read, something totally unexpected occurred! I am certain others have had a similar experience. Far from merely fulfilling the assigned task of reading, I found myself utterly captivated by Freire’s thinking – more so, Freire’s heart – Freire’s soul! Like the poetry described in Bob Dylan’s *Tangled Up in Blue*, “Every one of the words rang true and glowed like burning coal, pouring off of every page like it was written in my soul” (1975).

His words reached the passionate places within my spirit. I felt his passion as if it were my own, like it was written in my soul. He writes, “But, as a teacher, I must

open myself to the world of these students with whom I share my pedagogical adventure. I must become acquainted with their way of being in the world, if not become intimately acquainted, then at least become less of a stranger to it” (Freire, 1998, p. 122). This text speaks to my heart, to my core. His words reflect to me a lived experience, a passion I have long felt, the passion to know the learners with whom I interact. While Freire’s *Pedagogy of Freedom* (1998) speaks to many issues, and on many levels, I wish to focus on the essential theme of passion – a powerful force that brings hope. His text brought hope to my heart in a way I could not have anticipated.

As I read, I sometimes interact with the text by writing short comments or one-liners. When I flip through my copy of Freire’s classic work, still bearing the ironically true “used” sticker from the *Maryland Book Exchange*, I am reminded of the impact this work left within me. Close to half the words are circled or underlined. My comments fill the borders: “Very cool; thank you; excellent; great quote; yes; awesome, I love this; incredible; wow; powerful; right; amen; I agree; so great; I love this man.”

But the markings and wear, indicative of a loved and often read text, do not fully reflect the mark the text left on my heart. After the experience, I am different. Paulo Freire made an impression that allows me to be both more confident and yet more humble. I am more hopeful, and at the same time, more aware of my unfinishedness. I am more focused on the child’s perspective, yet somehow equally committed to self-reflection.

In the first lines of Chapter One Freire writes, “Two subjects occupy me in the writing of this text. The question of what forms education and becoming a teacher, and a reflection on educative practice from a progressive point of view. By progressive I mean a point of view that favors the autonomy of the students” (1998, p. 21). Likewise, I invite you, the reader, to recognize that it is my intention, through the body of this work, to reveal, to uncover, the lived student experience in an inquiry-based science setting. Such a setting is designed with a child’s autonomy in mind. Such a setting is theoretically structured to encourage thinking. Inquiry-based science is framed in a constructivist theoretical learning framework (Brooks & Brooks, 1993; Loucks-Horsely, et al., 1990; and Shapiro, 1994). In such a learning space, children are to be given space to construct their own understanding. I embrace the “idea” of inquiry-based science; however, I am committed to moving beyond the theory of inquiry-based science. Though my passions have led me to conduct such an inquiry, my fundamental commitment to this work is not to “prove” that inquiry-based teaching and learning is worthwhile. I investigate, fundamentally, in order to give voice to the child who experiences it. Their voiced experiences, then, can lead to improved pedagogical practices.

Freire calls educators to struggle for a human ethic. He states, “The best way to struggle for this ethic is to live it in our educative practice, in our relations with our students, in the way we deal with the contents of what we teach...” (1998, p. 24). The human ethic Freire articulates requires that we know what the child experiences, good and bad. It would be unethical to reveal any less.

Freire goes on to state, “I should stress also that this book is about hope and optimism, but not a false optimism or vain hope” (1998, p. 26). Freire’s optimism is empowering. His words of hope are encouraging; his words of hope *give* courage; his words encourage. My hope, my “expectation of something desired” (Onions, 1966, p. 447), is rooted in the possibilities that each child in my care will, in some way, benefit from the space I give. That is my hope, yet, I cannot know; I cannot make myself more aware; I cannot grow as a teacher, a learner, or a researcher merely on hope. That is why I seek to know, to listen, to take notice of the words and actions of the children in my care. In so doing, I can adjust to the needs of the individuals in the group. I can find, and define, more clearly what I can do in response to their needs and interests. And in doing so, I find greater hope, sense greater courage, and am better able to encourage those I am called to teach.

In the closing remarks of the introductory chapter, Freire writes, “Lastly, let me say what this book asks and hopes of you: That you give yourself to it critically and with ever-expanding curiosity” (1998, p. 27). Here Freire invites the reader into an active role as one relates to the text. He invites the reader to give something of self, not merely to get. It is unheard of in my educational experiences for a professor to ask what I have given to a text, yet I have often been asked what I got out of a book or article. Freire models a powerful approach, one that is inferred, if not explicitly articulated, in the inquiry approach. He invites us to think – to criticize – to challenge – to wonder – to open our minds – to risk asking questions without immediate answers – to taste the unquenchable he calls ever-expanding curiosity.

As an educator, Freire serves as a model for others in the field. His message is alive and calls to educators willing to listen. He calls for passion. His inspiration prompts me to respond. Still, I must ask difficult questions of myself. How should I respond? What is my role in the field of education? Where should I turn next? Which voices should I heed and which should I ignore? How can I hear the voice within? What about the voices that are least heard and most important – what about the voices of children?

The Passion of a Child

We each have a song in our heart
That can inspire us in good times and
Hard times if we take the time to listen. (Stepanek, 2002b, p. 25)

At the start of the fall semester of 2002, I met someone who affected my thinking in many and profound ways. I met someone with passion, a passion for life and a passion for impacting the lives of others, a passion unlike what I had known before. During introductions in a qualitative research course, Jeni Stepanek, a fellow doctoral student, introduced herself to the class. In her closing remarks she mentioned that her only surviving son Mattie, 12 years old at the time, had a book on the New York Times best selling list. No more was said, but her statement got my full attention. As others continued on, giving their names and sharing their research interests, I was lost in thought: “What kind of book had this child written? Did she say she had four children but only *one* was living? Why isn’t anyone asking for more details? Why am I just sitting here? Should I interrupt the speaker and bring the conversation back to her? No, I can’t do that! How can I find out more about her child and their story?”

A few days later, on a lazy Saturday afternoon, I was poking around the book section at a local store and stumbled upon a thin hardback book by Mattie Stepanek (2002b) titled, *Celebrate through Heartsongs*. I thought to myself, “Stepanek – that’s the name of the woman from class isn’t it? This must be the book she mentioned.” I flipped through it quickly, determining it was some sort of kid’s poetry and art book. “I am not much for poetry,” I thought, “but I am going to buy this book and see what it is all about.” At home, I sat in the living room, undisturbed, and read the short book of poetry from cover to cover. I sat very still in the quiet room, stunned into silence.

This was my introduction to Mattie Stepanek. I first befriended him through his writing and discovered more about him through his mother. Over time I learned of his condition, dysautonomic mitochondrial myopathy, a rare form of muscular dystrophy. One after another, I acquired his many books of poetry, and through reading and reflecting I was awakened by his life-changing message. The honesty and depth of his work inspired me to read more poetry, something I had not been inclined to do. Mattie’s work also inspired me to regain the courage to write poetry, a practice I had nearly forgotten.

On March 7, 2004, Mattie wrote his last poem, called “Final Thoughts.” The following day he suffered heart failure. On June 22, 2004, at the age of 13, Mattie Stepanek passed away. In his final work, Mattie writes:

Have you ever wondered
If some people will live, and live
And love differently after you pass?
Have you ever wondered
If the people will live and then
Sift and reflect on the
Wisdom of your thoughts and the
Gentleness of your words and the

Enduring consequences of your actions?
I have.
I have so, so
Wondered.
(In Stepanek, J., 2005, p. 205)

In response to Mattie's wonderings, my answer is a resounding, "yes!" The impact of his life on mine is profound. He has taught me to love with greater conviction, to hope with greater determination, and to celebrate with greater joy (especially after storms!). Perhaps most significantly, he reinforced for me the importance of listening to the voices of children, to *really* listen! What does it mean to listen? To *really* listen? The Old English word for listen, *hlystan* is formed from the word *hlyst*, meaning hearing (Onions, 1966, p. 531). To listen, then, is to hear and to hear requires that one listen. Freire (1998) says:

Listening is an activity that goes beyond mere hearing. To listen...is a permanent attitude on the part of the subject who is listening, of being open to the word of the other, to the gesture of the other, to the differences of the other. (p. 107)

My ability to engage students in inquiry-based science requires more than I thought possible. It requires that I listen, and hear, and maintain an openness. Only through a commitment to live out my passions will this be obtainable.

What is a Heartsong?

I have a song, deep in my heart,
And only I can hear it.
If I close my eyes and sit very still
It is easy to listen to my song.
When my eyes are open and
I am so busy and moving and busy,
If I take time and listen very hard,
I can still hear my Heartsong.
It makes me feel happy.
Happier than ever.
Happier than everywhere

And everything and everyone
In the whole wide world.
(Stepanek, 2001, p. 3)

Do I have a Heartsong? How can I hear it? How will I know it? How do I sing it? Is it through poetry? Through writing? I believe I do have a Heartsong. I believe we all do. I want to express it – I wish to be heard – I desire to be understood. And I hope to understand the songs of others.

But can we hear the Heartsongs of others? Is it like hearing the songs of birds? We can *hear* bird songs, but how much time and effort must it take to interpret the meaning? What must I do to *hear* the songs sung by my students? Are their songs equally difficult to interpret? Is it worth the effort? What are the children saying? I am not interested in just the sounds, like the birds, but the meaning – the deeper meaning.

I believe the voices of children often are overlooked, misinterpreted, or ignored. Like the birdsong, they are heard but not considered, perhaps even “enjoyed,” but not taken seriously. How often have I heard the birdsong and found joy in it without fathoming any meaning? Likewise, I often take joy in songs on the radio, even though the words hold no meaning to me; the words are present but overlooked. Is this how I treat the meanings of children’s voices – a pleasant sound perhaps, but with little attempt to understand?

I want my writing to sing. Perhaps first I need to listen closely for my Heartsong. I want my song to be heard and understood. Perhaps I first need to listen to the songs of others and seek to understand them.

Mattie Stepanek's message, like Paulo Freire's, is an exhortation to each of us to find our passion. It is not a call to get something out of the text, but rather, a call to give ourselves over to the text and allow our hearts to reveal an appropriate response. I struggle to hear the voice of my heart. I struggle to interpret the voice of Mattie Stepanek. I struggle to know; yet in the midst of the struggle, I know that the struggle is good.

The Passion of an Astronaut

The sessions I chose to attend during the 1997 National Science Teachers Association (NSTA) conference are indicative of my lifelong passion for space and everything related to the space program. On Saturday morning I found the following session description in the program catalogue:

The Ten Thousand Night Dream: Stories from Space

Feel the excitement and emotion as retired Air Force Colonel Mike Mullane tells about his extraterrestrial travels – as well as an astronaut's life on earth – with wit and humor. Share the deeply personal human drama that an astronaut lives in the final 36 hours before a space mission. With a brief reading from her diary, Mrs. Mullane provides the audience with a glimpse into the often forgotten drama that astronaut spouses live. You'll laugh and learn with the Mullanes – and discover the space explorer that is within us all. (April 1997, excerpt from NSTA Program Catalogue, Las Vegas, Nevada)

Yes! This was definitely a session I wanted to attend. Key words like *stories*, *emotions*, *humor*, and *drama* called to my interests and passions. The title alone was enough to capture my attention. "The Ten Thousand Night Dream." Wow! There is power there. Do we not all have dreams – aspirations – hopes? What is the story of someone's lifelong dream? And the final phrase of the description made the session irresistible: "...discover the space explorer that is within us all." Is there truly a space

explorer within each of us? I wonder. Somehow I know that this statement is true of me, even if at some unrevealed level.

As the session begins, Mike Mullane, a three-time space-shuttle astronaut proceeds to tell his story through a dramatic presentation of his lived experience in space. His Heartsong is heard loud and clear. He begins this way:

The Sky. The Sky.
Throughout my life I have found such happiness in its immensity.
Such peace and joy and beauty in it.
As a child I constantly looked into it
And dreamed of joining the soaring birds,
Riding through billowing clouds.
Where did this passion come from?
From my father, a World War II aviator?
From my mother, this beautiful young bride that filled all of her
Children with a love of all of God's creation?
I cannot know!
But always...always the sky has beckoned
The sky and its companions,
The wind and the stars and the moon.
There had never been any doubt about what I wanted to do with my life.
I wanted to fly!
Fly higher and faster... (Mullane, 1991, *The Ten Thousand Night Dream*)

Mike Mullane's passion became his purpose – his calling. As I reflect on his story I, too, sense a passion and a calling. I, too, wish to discover my Heartsong. And I desire to give children space to discover their Heartsongs as well. As I listen to children, what will they reveal? What are their passions? What experiences shape their thinking and how? What influences will permeate their dreams?

Describing the range of emotions lived hours before launching into space,

Mike Mullane continues:

To the cheers of more workers we climb aboard the crew vans to begin the ten-mile drive to the launch pad. I'll tell you something, no journey, no journey anywhere, begins with greater intensity of emotion than does this one. Many have cried on this trip, the gushing tears of

joy at the realization that a dream of ten thousand nights is finally coming true. That they are finally going to fly into space. Others turn silently inward. Only they knowing how they battle their gut fear and celebrate their boundless joy. Still others hide behind meaningless joking talk... (Mullane, 1991)

A ten thousand night dream! A dream 30 years in the making! A dream finally realized! What must it feel like to reach such a place? If one could see a dream, what might it look like? Through poetic voice he describes his dream as viewed from space:

Then home, Albuquerque, comes into view.
Tears blur this image.
I am overcome with the poignancy of the moment.
I am looking into the cradle of my dream.
It was here...from these deserts that as a child
I had launched my homemade rockets
Here – Here I had stood and looked into the sky
And watched satellites called Sputnik and Explorer and Vanguard
Twinkle through the New Mexican sky
While I had wished and wished and wished
That someday I could join them.
I squeeze the tears from my eyes and they float in front of my face
As crystal jewels
And once again prayers of thanksgiving fly from my soul.
(Mullane, 1991)

I listen to Mike Mullane's words and I am inspired! He never had any doubt about what he wanted to do. He wanted to fly! To travel to space! And he made it. His ten thousand night dream was fulfilled. I think of it – and I wonder – and I cry.

But I have no such dream. Or do I? Never have I been so passionate about “doing” something. Or have I? So I ask, what is my “ten thousand night dream?” Do I have one? Do other teachers experience such powerful emotions, or is such longing reserved only for travelers and adventurers? Is there an explorer in each of us? Do children have such dreams? Is such passion a common human emotion, or is it only

found in a rare few? As I wonder, I start to recognize that I do have my own dream, not a dream to “do,” but a dream to inspire *others* to do. I am not so much a dreamer as a dream-maker, or at least one with a passion to be. Perhaps this is the dream that calls every passionate teacher – the calling to inspire, the hope to encourage the willing toward their dreams, the force to motivate learners to seek the space they dream about, the faith to inspire courage to stand against the odds.

What is the lived experience of a teacher in the elementary classroom (or in any classroom)? That is the story each teacher could tell, and each story would be unique. I want my story to go beyond just a telling of the events that take place. I want to express my own “ten thousand night dream” and I want to listen as my students share theirs. Van Manen (2003) reminds us:

We need to act in the lives we live, side by side with our children, but then also wonder, always wonder whether we did it right. We need to “listen” to pedagogy so as to be able to act in a better way pedagogically tomorrow. (p. 149)

I want to *hear* students as they express their depth, their passion, their inspiration. This is the story I hope to tell. My story – their story – our story, as we experience space science inquiry together.

Finding the Connection: Passion

The educator, Paulo Freire, reveals his hopes and calls us *to* hope. The child poet and peacemaker, Mattie Stepanek, sings his Heartsong and implores us to discover ours. The astronaut, Mike Mullane, reveals his dream and invites us to dream our own personal adventure. Each of their stories calls us to action. If we choose to respond to their message, we must change. Though they come from wildly varying cultures and life experiences, the binding force between each of these

individuals can be found in their passions. They lived their passions, and through their writing, provide a window for us to observe their experiences, which ultimately reveal their passions. Through their writing, they call us to discover our own passions, and they encourage us to live out these passions as well.

William Wallace is a historical figure from early 14th century Scotland who led his people to oppose English rule and fight for freedom. In the aptly titled film, *Braveheart* (1995), Wallace is confronted with a life or death choice. If he renounces his beliefs, condemning his acts of rebellion against the English throne, he may be permitted to live. But, if he chooses to remain silent, he will certainly face torture and ultimately death. He chooses death. When faced with the choice, he states, “Every man dies, not every man really lives.” In the context of the story, his proclamation implies that if you follow your heart, live whole-heartedly for what you believe in, then you will truly live, even if it means you must die. Yes, it is just a movie, but the implications are staggering. I wonder about the “bravehearts” I so much admire! What kind of choices did Paulo Freire make that led him to find hope while remaining forever unfinished? How did Mattie Stepanek rise above his day-to-day suffering and truly live his convictions? What sacrifices did Mike Mullane experience in order to see his “ten thousand night dream” fulfilled? If we are willing to live a life of passion - *patti*, we may suffer, but in so doing, we will experience life to its fullest. If we are to live our passion, we will truly live. I choose to live!

Space Science Inquiry – Using Phenomenology as a Guide

When a great moment knocks on the door of your life, it is often no louder than the beating of your heart, and it is very easy to miss it. (O’Donohue, 1997, p. 8)

Sometimes life's greatest moments are difficult to identify as we are living them. On the night of April 22, 2004, I experienced just such a moment. Dr. James Limbaugh was the guest speaker in Dr. Hultgren's course, Phenomenology I. Although I entered the classroom with typical anticipation (each week would offer some level of insight and inspiration), this night was subtly different. After an introduction, Dr. Limbaugh shared his experiences as a doctoral student at the University of Maryland, how he had moved through his coursework and confronted the possibility of focusing on phenomenology as a methodology for his dissertation. As I listened, my mind filled with questions. A myriad of possibilities flooded my thoughts. As he shared his passion for guiding college freshman and articulated his lived experience with phenomenology, I was scribbling pages of notes, trying to capture all that he was saying.

At one point I ceased to hear anything else or notice anyone else in the room. I was lost in thought. Certain I was about to capture some kind of important insight or some significant life direction, I uncharacteristically jotted the time (8:41) into my notebook, as if I needed to document the exact moment of some great event. Next I wrote:

Right now I
have considered
"I can't do this. I can't "do"
the philosophers – I can't do it
and,
Wait, I can do this. I could make this work. I can take 780 & Phenom
II
in the fall – thurs pm
I can
Both answers come to me over
& over –
I'm afraid to

I'm afraid not to
(Horne, April 22, 2004, from class notes)

A battle raged within my mind. I knew (sometimes you just know), that I was supposed to press forward and allow phenomenology to guide my writing. Yet, while I knew this, I was also pushing forward in the dark. I did not know what it would mean to head in this direction. Over time, all the necessary answers came and all of the details fell into place. I was able to move in the direction of phenomenology. Now the question remains, "What will phenomenology, if I allow it, do with me?" (See van Manen, 2003, p. 45).

Turning to a Methodological Structure

In his seminal work, *Researching Lived Experience*, van Manen (2003) describes a methodological structure of human science research. He states:

How can human science research be pursued? Reduced to its elemental methodological structure, hermeneutic phenomenological research may be seen as a dynamic interplay among six research activities:

1. turning to a phenomenon which seriously interests us and commits us to the world;
2. investigating experience as we live it rather than as we conceptualize it;
3. reflecting on the essential themes which characterize the phenomenon;
4. describing the phenomenon through the art of writing and rewriting;
5. maintaining a strong and oriented pedagogical relation to the phenomenon;
6. balancing the research context by considering parts and whole.
(pp. 30-31)

Van Manen is careful to explain that "...the separation into six methods is somewhat artificial. Different distinctions could have been made, and in the practice of human science research the various methodical activities cannot really be performed in isolation" (van Manen, 2003, p. 30). You will recognize elements of each of the

research activities throughout this text. The primary focus of this chapter is to provide a window into my turning to the phenomenon of the lived meaning of children's experiences in space science inquiry. It should be noted, however, that the process of writing and rewriting is the fundamental means by which understanding has emerged. Intuitively, I knew I had an abiding interest in space science and a fierce passion to work with young people, but it was only through deep reflection and a commitment to the writing process that I was able to capture meaning from experience.

Reflection led me to an unsettling question early in my work in phenomenology. I asked, "Why is it necessary or important to know what the experience is like for the child?" I could not believe I was wrestling with this question. I had been consumed by an interest in the child's perspective, but suddenly it seemed as if I doubted the relevance of the inquiry in which I was about to start. I struggled with the temptation to dismiss the question because it did not align with my beliefs. Instead, I took hold of the thought, allowing myself to scrutinize my intentions – what van Manen refers to in the six research activities as "maintaining a strong and oriented pedagogical relation to the phenomenon." This kind of pedagogical relationship allows the researcher to question the meaning of the research and remain open to revisit doubts and questions often. After further reflection, I considered that perhaps my doubt reflected a continued stronghold on my thinking that gives primacy to "self," elevated the importance of "teacher," and overstated the value of "the act of teaching." I had inadvertently overlooked the essential value of the learner and the interactive nature of the art of teaching and learning as experienced by both the teacher and the learner. Through writing and reflecting I was

able to strengthen my commitment to the research activity, orienting myself to the importance of the work, while recognizing the value of thinking deeply about the child's perspective.

Human Science Research as a Caring Act

Van Manen says, "Research is a caring act: we want to know that which is most essential to being. To care is to serve and to share our being with the one we love. We desire to truly know our loved one's very nature" (2003, p. 5). I understand this desire. My longstanding passion is to know the children, to understand learners by understanding their perspective, to understand learners by understanding the lived meaning of their experience. Nel Noddings says, "The word caring, can of course, be used to refer to an attitude, but it can also be used to describe a relation or to point to something far deeper and more important – a way of being in the world" (Noddings, 2001, p. 99). This "way of being in the world" describes the actions of a teacher, as well as the actions of a researcher, committed to giving meaning to experience.

Concerning the caring teacher, Noddings goes on to say, "If we examined how we are when we care, we see...that we are attentive...we are receptive" (p. 99).

Phenomenology draws the researcher to a place of receptivity to the lives, the thoughts, the feelings, and the very hearts of those living the experiences in which the researcher has a deep interest. The human science researcher is receptive to the immediate needs, interests, and emotions of those in their care.

Van Manen (2003) states, "Indeed, if there is one word that most aptly characterizes phenomenology itself, then this word is 'thoughtfulness.' In the works of the great phenomenologists, thoughtfulness is described as a minding, a heeding, a

caring attunement (Heidegger, 1962) – a heedful, mindful wondering about the project of life, of living, of what it means to live a life” (p. 12). The thoughtful, caring act of phenomenological research requires a deep commitment on the part of the researcher, a commitment I am called to make and prepared to accept.

Receiving Space through Phenomenology, Giving Children Space

Space lies open; it suggests the future and invites action. (Tuan, 1977, p. 54)

Phenomenology offers me a unique kind of space. I experience a new level of freedom through this kind of human science research – a sense of spaciousness. I am invited to think deeply about human experience, as it is lived, rather than relying on theories and strategies to explain human action. This freedom brings hope and encourages a commitment to action. Through the phenomenological process of working closely with children, videotaping, conversing, transcribing, discussing, wondering, writing, reflecting, and re-writing, a central theme slowly emerges. I began to see that the kind of space I am afforded through phenomenology can be offered to my students. I begin to recognize the power and primacy of “giving children space” in the context of an inquiry-based space science classroom.

Certainly the metaphor is not new, nor is it unexplored in educational circles. Parker Palmer points out that, “Space without boundaries is not space, it is a chaotic void, and in such a place no learning is likely to occur” (1998, p. 74). It may be regarded as common knowledge that children “need space,” but, in order to capture the lived meaning of giving and receiving space in the context of an inquiry-based classroom, many questions need to be explored. What boundaries are needed to transform the chaotic void to a learning space? How do we experience space? What is

the difference between space and place? Is space an inherent aspect of inquiry-based learning? What are the different kinds of space? When is space experienced positively and when is it not?

Sometimes space suggests distance – breathing room if you will. But, how much space is too much? Consider the interplay of the earth and sun. Would anyone suggest that the sun is too close to earth? Too far? As a point of fact, our very existence is made possible in large measure because of the space between the earth and the sun. Change the distances by a small percentage and all of our lives would end abruptly. It seems that we have been afforded just the right amount of space. The sun, an average of 93 million miles from us, provides just the right amount of heat and light to sustain us. Walk outside on a sunny day and you can experience the tactile nature of the sun, its life-giving rays reaching us at a speed of 186,000 miles per second. You feel its warmth on your face. You can sense its closeness and power. Still, you appreciate its distance; much closer and it would destroy you. Just a few million miles further away and you would not survive.

The desire to give children the right amount of space is one of caring, a thoughtfulness to give them just what they need. Not too much space or too little – just the right amount to sustain them and allow them to thrive. Human science research can allow the researcher to give space and to understand how that space is experienced. In phenomenological research, the emphasis is always on the meaning of lived experience. “The point of phenomenological research is to ‘borrow’ other people’s experiences and their reflections on their experiences in order to better be able to come to an understanding of the deeper meaning or significance of an aspect

of human experience, in the context of the whole of human experience” (van Manen, 2003, p. 62). Throughout this inquiry, I seek to uncover the meaning of space as I explore the essential question: **What is the lived experience of 4th grade students engaged in the process of space science inquiry?**

Looking Ahead

In Chapter Two, I continue to intertwine van Manen’s six research activities. Through description and reflection of classroom experiences, I open the phenomenon of space science inquiry to a deeper level of understanding. Particular emphasis is given to the key players, the students. Through exploration of the metaphor, “giving children space,” emerging themes are uncovered.

CHAPTER TWO:

LISTENING TO CHILDREN: TELLING THEIR STORIES

Dear Mr. Horne,

...I liked when we went outside and did relative distances with the models. I liked it because we got to go outside. I also liked it because it was with the models.

Sincerely,
Matt

Dear Mr. Horne,

It was fun when we did the science talks. It was fun because one person would come up with a conclusion and then another one would and it would become a huge argument...

Sincerely,

Jon

Dear Mr. Horne,

...I also really liked the science talks because everybody could speak their opinions and none of the teachers said anything so it [was] all a kids conversation...

Your Friend,
Bradley

Dear Mr. Horne,

...I also really liked you teaching us that the sun is 1 million times bigger than the earth (Waaaaaaaaay Bigger)!...I thought the interview was cool because it was only you and I talking about science instead of a whole class...

Sincerely,
Libby

Dear Mr. Horne,

...It was cool how we would always say, "NOTHING!" after someone asked what we learned because there's mostly nothing in space...One more thing, that interview was kind of scary because you know me I'm scared to talk in front of cameras and on stage. Well, you still were and still will be a good-great teacher. All those times we had will be memorized by my family and I.

Thanks Again,
Shanetta

Dear Mr. Horne,

I think the samoan circle was fun because we each got to take turns talking. We were taking turns telling what we think...

Your Student,
Tanya

(Letters written by students in Mrs.V's 4th grade class, May, 2005)

Establishing a Strong Pedagogical Orientation

Pedagogy is a fascination with
The growth of the other. (van Manen, 1991, p. 13)

As the chapter opens, you read excerpts from a small sampling of letters from Mrs. V's class, composed near the end of the school year. As you will recall, over the past several years Mrs. V has welcomed me to share the space science curriculum with her students. As a visiting instructor in the space science classroom, I reflect on the year and ask, "What do these responses reveal about the experiences the children had in the space science classroom? Did the students have a true inquiry-based science experience? What do the children's voices tell us?" These questions are difficult to answer – especially with the limited student voice provided thus far. But, what can be discovered by looking closely at students' experiences?

In this chapter I present material chosen to illuminate the experiences of children in the inquiry-based classroom and place it in juxtaposition with voices from many disciplines, including the fields of the human sciences and science education. As I do so, I remain mindful of van Manen's six research activities including the importance of "maintaining a strong and oriented pedagogical relation to the phenomenon" (van Manen, 2003, p. 31). To remain fixed on the children's experiences, I listen and re-listen to the recorded voices of children during classroom sessions at the moment they lived the experience. But in my listening, do I hear? In order to grow in my understanding, I must quiet myself and allow my heart and my mind to focus. I am challenged by Levin (1989), who writes:

Why do we not listen to our children? Why do we not hear what they are telling us? Do we not need, all of us, to learn what it means to

listen, really listen to our children? If we practice the art of listening, of welcoming their experience, we might learn something. (p. 86)

I practice another form of listening as I spend time reorienting myself to the children's writing by reading and re-reading their class assignments and letters. I watch a video of one-on-one student dialogues and small group conversations in order to place myself back in connection with the children's voices and body languages as they reflect on their experiences. Also, not to be underestimated, I write. As I do so, my attitudes, my beliefs, and my thoughts begin to surface. Each of these practices allows me to maintain a closeness to the actual experience of the inquiry-based classroom, rather than drifting to a conceptualization of the experience. It is only with such a grounded vantage point that I can effectively consider and draw meaning from other voices from the field.

The work presented here is not comprehensive in the sense of being an exhaustive analysis of the children's experiences. It cannot be. Even though I have collected massive amounts of material and reflected specifically on student experiences in the space science classroom since the 1999-2000 school-year, in the big picture it is still a very small sampling. Instead, I seek to demonstrate a commitment to listening closely to the lifeworld of children over an extended period and provide a sound narrative of these experiences. These narratives are brought forward for the purpose of exploring the phenomenon: the experience of children engaged in the process of space science inquiry.

Van Manen (2003) provides insight to the human science researcher, reminding us of the sharp contrast between a phenomenological study and other methodologies. He states:

The preferred method for natural science, since Galileo, has been detached observation, controlled experiment, and mathematical or quantitative measurement. And when the natural science method has been applied to the behavioral social sciences, it has retained procedures of experimentation and quantitative analysis. In contrast, the preferred method for human science involves description, interpretation, and self reflective or critical analysis. (p. 4)

As I seek to remain sensitive to the demands of phenomenological writing, in the pages that follow, I provide descriptions, interpretations, and analyses of the phenomenon of the lived experience of children in an inquiry-based space science classroom. As I look closely at the phenomenon, I notice emerging themes (van Manen, 2003), which have allowed me to gain an initial sense of what lies at the core of such an experience. The text that follows is organized around these themes and sets the stage for my continued interpretation of the student experiences during my formal study.

Wonder in the Inquiry-Based Classroom

In-class assignment:

Write down something about space that you wonder. I wonder...

I wonder how a meteor shower happens. (Jason)

I wonder if there is life in space. I wonder if scientists will find a new planet. (Carleena)

I wonder if we are going to move to Mars because...earth is going to come apart. (Roland)

I wonder...How was science even started? (Aubrey)

I wonder how the stars transformed into things like the Big Dipper and the Little Dipper. (Emma)

I wonder if time travel is real, or if there's a parallel universe. (Jared)

I wonder how many stars are in the sky. (Karla)

I wonder why there is not any oxygen in space. (Raquel)

I wonder...Has any ship been sucked by a black hole? (Kelly)

I wonder why I wonder. (Pat)

(“I wonder...” responses written by 4th grade students during a space science lesson taught by Chris Horne, September 4, 2003. See listing in Appendix A)

Children wonder. Me too. At the starting line of inquiry, we wonder. Void of questions, unknowns, wonderings, there can be no inquiry. The essence of this study is a dwelling-with in the inquiry-based classroom, as they wonder and I wonder along with them, wonder about them and wonder how to interpret and share their wonderings. As I reflect on all the children say, again I realize I must allow the children’s words to inform me about their thoughts, their interests, and their questions. If I pay close attention to these students, their minds, their hearts, and their actions, what will they reveal? What will I discover?

Entering the Classroom Experience – Inviting Children to Wonder

If we explore the kinds of thinking elementary children are capable of, we cannot help but wish we had the same capacity ourselves. When we are able to resurrect our own wonder and our natural imaginative response to the world, we can better teach our children... (Gallas, 1995, p. 102)

It is early September. Just the 2nd week of school. Today, I meet Mrs. V’s 4th grade students for the first time. Though I am not their full-time classroom teacher, for the year ahead, I will be their space science teacher. I know what I want to accomplish this day. My primary goal is to establish a degree of trust with the children so they will begin to reveal their questions about space, their level of interest in the subject matter, and their degree of curiosity. In *Inquiry and the National Science Education Standards* (2000), the National Research Council states:

Inquiry is in part a state of mind – that of inquisitiveness. Most young children are naturally curious. They care enough to ask “why” and “how” questions. But if adults dismiss their incessant questions as silly and uninteresting, students can lose this gift of curiosity. (p. xii)

I cannot afford to set the wrong tone during our first meeting. I am determined to nurture the gift of curiosity in each student. I am committed to care enough to hear their questions. I am hopeful that I will encourage the children to share the inquisitiveness they possess.

As I enter the room, all of my plans, all of my dreams, all of my hopes, and all of my knowledge suddenly seem insignificant. My mouth feels suddenly dry. I want to give them space, but how? My mind goes blank. Where should I start? How can I show them I really care?

I know so much; I love the subject matter so much; I care about children so much. But, they do not know much about me. They cannot possibly imagine nor appreciate the profound affect others such as Paulo Freire, Mattie Stepanek, and Mike Mullane have had on me. They cannot imagine the hope I have and the desire to pass on this hope. They do not know how sincerely I wish to know their minds and hear their hearts – their Heartsongs. They cannot fathom how much it means to me to help them to listen for their “ten thousand night dream.” They are not certain that I am someone they can trust, or someone with whom they can share. So, they are quiet – and I am nervous. I have taught in elementary schools for twenty-some years, yet I still feel awkward. There are so many things I wish to tell them, but as I mentally rehearse the comments I might share, they seem hollow. I fear my gushing of words will hold little meaning for the children. The first words I manage to speak sound

limp. I ask if they know anything of Sir Isaac Newton and the response is obligatory: “Sure – yes.” More words follow, but they are delivered with little enthusiasm.

I quickly move to simple introductions. First I introduce myself, though I had met some of the children the year before. Then I ask students to tell their names and something they like about science. As they share, Mrs. V, the classroom teacher, records their words as I take their picture with the digital camera. This is the first opportunity to listen for insights about each child. Alan says he loves space. Betsy likes experiments. Miguel is interested in nature. Unfortunately, I do not have the capacity to remember all of their comments, so having a written record allows me the opportunity to revisit their comments later – to re-member. The root, *member*, comes from the French *memoire* or memory. Mrs. V’s written comments serve as a memoir – a note or *memorandum* – a Latin word meaning “used to help the memory” (Onions, 1966, p. 568). The written comments help me; I rely on them to remember. But, how important is it to remember that Miguel has an abiding interest in nature? How will my memory of Miguel’s interest impact his experience in the space science class? What might I say or do in the weeks and months ahead that will demonstrate my memory of Miguel’s interest? What memories will Miguel retain regarding the space science classroom experience?

Casey’s (2000) phenomenological study, *Remembering*, brings light to many aspects of remembering, such as, remembering-*things*, remembering-*that*, remembering-*how*, and remembering-*to*. He distinguishes between primary remembering, a remembering that needs no recall because the experience is still present in the mind, and secondary remembering, requiring one to re-remember,

resurrect, or recollect the memory from long-term storage. Casey refers to this as, “a resuscitation of previously experienced objects, events, and circumstances” (p. 51). As I consider the lived experience of children in the inquiry-based classroom, it will be necessary to attend to those experiences that profoundly impact memory and to reflect on the significance of memories, both primary and secondary. But here, at the outset of our learning adventure together, it is essential to learn, remember, and use the children’s names with ease – a kind of first-step to building relationships. Later tonight, when I have time to concentrate, I will scroll through the digital pictures over and over, matching names with faces until I am convinced I can greet each child personally during my next visit. If I want them to know me, trust me, and share in honest dialogue with me, I must know them, and the power of knowing their name is a good starting point.

As I work through the group, taking pictures, listening to their comments, and engaging in conversation, I sense the tension easing. Attitudes are forming, barriers are lowering, and moods are lightening. It is the first day, and already I feel as though it is going to be a great year! I wonder if the children have similar feelings. I wonder how they experienced the day. I wonder how I can find out.

At the close of our time, I give the students a simple assignment. I ask them to write “I wonder” questions (see student responses on pp. 55-56). Specifically, I ask them to share something they wonder about space, our overarching topic of study. This writing assignment provides an opportunity for them to reveal their questions, their confusions, and their curiosities. After explaining the assignment and its purpose, the students begin without hesitation.

As they write, my mind wanders and I wonder: Have these children ever been asked in school to share their “I wonders...?” If so, what was the experience like? Will they expect immediate answers to all of their inquiries? Do they really wonder about the things they write, or are they merely responding mechanically to my directions? Hopefully, their writing will provide important insights. Tonight, when I read through their responses, what will I discover about them?

Attending to Children’s Wondering - Knowing Their Minds, Knowing their Hearts

Children reveal their minds, their hearts, and their questions more freely with pencils than with lips. (Horne, 2008, reflective journal)

In response to the “I wonder...” question, the children respond, as children often do, with amazing honesty. They barely know me, yet they openly share their questions, and their wonderings, merely because I asked. They have made themselves vulnerable. They have allowed a teacher they barely know to see their thinking, consider their questions, and gain access to what they do not yet know. By revealing what they do not know, to someone they do not know, they make themselves known.

As I read through the children’s “I wonder...” questions again and again, I find myself utterly amazed. I am compelled to linger. I slow the pace of my reading. I allow myself to wonder. I give myself space to dwell on each thought. To dwell is to “reside.” To *dwell on* is “to linger over in thought” (*Webster’s New World Dictionary*, 2001, p. 444). Jared wonders “...if time travel is real.” Karla writes, “I wonder how many stars are in the sky.” Carleena ponders if “...there is life in space.” As I reside with their words, as I linger with their thoughts, I sense a closeness I could not have experienced without taking the time to dwell.

The responses suggest curiosity, imagination, and interest. I close my eyes and wonder, “How should I respond to the rich and diverse collection of inquiries? How can I possibly provide a meaningful learning experience to this group of students in the weeks and months ahead? What kind of learning space can I create to serve these amazing children?” Suddenly the notion of using an “inquiry approach” seems inadequate. No teaching “approach” can help me resolve the question of what I should do in the upcoming months. No teaching “method” will suffice to provide space and time to resolve the questions the children poured onto their papers in a matter of minutes.

Palmer (1998) says, “The connections made by good teachers are held not in their methods but in their hearts – meaning *heart* in its ancient sense, as the place where intellect and emotion and spirit and will converge in the human self” (p. 11). Certainly I know something of “inquiry-based science,” yet I do not know these children. I do not know their hearts. Jason states, “I wonder how a meteor shower happens.” Does Jason know a great deal about meteor showers already? Why is he curious? What might be the best pedagogical course of action? Should I answer his question or does he need the space and time necessary to discover something about meteor showers on his own? Pat writes, “I wonder why I wonder.” What a profound statement. How can I give adequate space to probe his inquiry? Should I pose Pat’s metacognitive question to the class? Should I ask him to elaborate on his thinking? Should I ask him why he did not address the topic of space as the assignment directed? Should I merely drop the matter altogether? And what about Carleena’s response? She writes, “I wonder if there is life in space. I wonder if scientists will

find a new planet.” What do her statements reveal about her? Does she ask because she is afraid? Does she ask because she is interested in looking more deeply into this question? I do not know Carleena so I can only guess. In a single class meeting, I cannot determine very much about any one individual in the class, but I can be deliberate about building a deeper understanding of the children’s thinking and making an effort to form meaningful relations. Van Manen (2003) reminds us that in any lived relation:

... the child experiences a fundamental sense of support and security that ultimately allows him or her to become a mature and independent person. (p. 106)

Support, security, and trust are the fundamental building blocks of relationships. They cannot be manufactured in a day. I do not hold high expectations in this regard for any first encounter; it is time and space that will create the necessary atmosphere for significant relationships. But, what about the space necessary for an impacting experience? Can one meeting set the tone for all subsequent encounters? What is the significance of the first impression? How will the students remember the first day? How will the experience be remembered in light of a whole year of experiences? How will the passage of time impact the memory of their experiences? I want to know, so I look closely at the experiences of children in the space science classroom and listen closely to children’s reflections as they shed light on these questions. I continue to express confidence and trust in these students as we build relationship. And, of course, I practice what the children so beautifully and naturally model – I wonder.

Wondering about Wondering: The Importance of Asking

As a starting point for the year, the children's "I wonder..." questions can open space that would otherwise be unavailable. I can fine-tune my lessons to address the questions and confusions of the class, rather than relying solely on my own preferences to drive the particulars of the day-to-day instruction. Why would a child, or anyone for that matter, engage in a process of learning answers to questions that they have never even asked, especially in a context where their own questions have not even been addressed or considered? Please understand: the "I wonder..." question is no proven "strategy" for success. Some children do not have a head full of wonderings ready to pour out; others have so many questions it would be unmanageable to address them all.

Ask adults the question, "What do you wonder?" and you may be surprised by their responses. Sadly, many have completely given up the practice of wondering. Why is that, I wonder? Perhaps the practice of wondering fades because "not knowing" has a negative connotation in our culture. Adults, especially teachers, think they are supposed to know; wondering demonstrates a not knowing. Perhaps we do not share our questions because we do not take the time to wonder, or to even wonder what we wonder. Perhaps we have just forgotten *how* to wonder. But is the practice of wondering about that which we do not know lost in adulthood, or do children forget to wonder too? In *Talking Their Way into Science*, Karen Gallas (1995) makes this observation:

I often point out in speaking about *Science Talks* to teachers and parents that I never talked about science as a child. In fact, no one I knew ever talked about science. It was a field that had nothing to do with my life; it employed a language in my native tongue that I could

not speak fluently. As a result, I, along with many other children, came to the conclusion that I wasn't good at science. It seems sad that this notion of not being "good at science" lives for many children today (and for their teachers), because after collecting data on science talk for 5 years I haven't yet met a child (or an adult) who was unable to think and talk like a scientist. (pp. 2-3)

Do the children in Mrs. V's class think they are good at science? Do they think they think like scientists? Do they feel confident in their ability to speak the language of science? Have they been allowed the space to ponder questions for which they have no answers? I wonder about the impact of giving children this kind of space. I wonder about giving children time to wonder. I wonder how the children experience "not knowing" day after day in the space science classroom. Still, I am unsure. Still, I am searching. Still, I wonder.

Wonder!

Children wonder. Do you?
So many questions,
Answers so few.
Boldly they ask,
How?
When?
Where?
Why?
What if?
Who?

Dare to wonder. Shouldn't you?
Face the questions,
Be open to what is true.
Yet you ask, but
How?
When?
Where?
Why?
What if?
Who?

Do not fear.
Do not worry.

Seek answers and
Ask the questions...
The never ending questions.
Like a child...
Wonder!
(Horne, 2008, reflective writing)

The ways in which I respond to the natural curiosities of the children in Mrs. V's classroom can have a profound impact on their experiences for the remainder of the school year, and even beyond. I must allow them to ask real questions, but even more so, I must allow them to wrestle with *their* questions. In *The Tone of Teaching* (1986), Max van Manen brings light to an important dysfunction that can occur in a learning environment when the issue of questions, answers, and curiosities are not carefully addressed. He states:

An impossibly curious child has already learned the wrong thing from adults: questions can be stopped by answers. This kind of child experiences questioning as a kind of a game, a game of finding answers that stop questions dead in their tracks. There is a certain feeling of security in a world where, at least in principle, every question has an answer – in a world where we experience things as being solidly grounded, where every question finds its place in some rock-bottom sense of natural order and certainty. And yet this security is a false one. (p. 40)

Gadamer (1960/1989) says, “The essence of the *question* is to open up possibilities and keep them open” (p. 299). This way of thinking must become engrained into the culture of the inquiry-based classroom. Each day must be dedicated to the supremacy and the importance of the question – giving proper space for possibilities.

On our first day together, I make explicit to the students that the primary goal of our space science unit is to finish with far more questions than answers. I explain that we will do this, not so we will wind up frustrated and confused. Of course not! The challenge I set before the students in an inquiry-based classroom is to pose

questions – real questions, tough questions, our questions – with the full understanding that we may not find answers, or be able to answer all of them. I must encourage and promote a classroom community that will “open up possibilities and keep them open” (Gadamer, 1960/1989, p. 299). The critical first step is to move away from the type of dead-end thinking van Manen refers to that engages children in answering questions for the sake of collecting an endless series of facts. He elaborates on this point:

Rather than seeing a child’s question as something that needs a quick and simple answer, the adult should try to help the child in his or her natural inclination to *live* the question. I wonder why the sun is so hot? I wonder how the earth was made? I wonder where I came from? I wonder why the leaves turn color and fall off trees? Each of these questions is worth pausing for. (1986, p. 40)

As I experience a new school year, a new classroom, and a new group of children, am I willing to give children space to pose their questions and give them time to pause long enough to recognize that their questions matter? Am I willing to listen closely to their words and attend to their actions in the space science classroom? Am I willing to demonstrate care in such a way that students have opportunities to experience a truly inquiry-based classroom? And even if I do all of these things flawlessly, I cannot forget the essential purpose of the research: Can I capture the essence of the experience from the children’s perspective? One clear way to view the inquiry-based classroom experiences of a child is through the window of *wonder*.

Space to Wonder

I observe the sky and I marvel.
I observe the eyes of the young
...and I marvel.
Colors.
Shadows.
Majesty.
Peace.

What do the eyes of the young
observe?



(Image 2.1 Horne, 2003, Mount Airy, Maryland)

I see the moon and I pause.
I see the child
...and I pause.
Light.
Mystery.
Beauty.
God's creation.

What does the child see?



(Image 2.2 Horne, 2004, Mount Airy, Maryland)

I look into the heavens and I wonder.
I look into the classroom
...and I wonder.
Stars.
Possibilities.
Questions.
Curiosity.

What do the students wonder?
(Horne, 2006, reflective writing)



(Image 2.3 Horne, 2005, Mount Airy, Maryland)

Community in the Inquiry-Based Classroom

I finally got a chance to explain to Desiree my theory of what it would be like with no moon...Desiree FINALLY got it. I really remembered those times. (Madison)

I like how you talk about your family but still talk about science. (Trent)

You always make us laugh sometimes by talking about “altoids.” Most of the time after every subject you would always stop and see what we have learned and if we had any questions. (Sophie)

My most vivid memory when Mr. Horne was here was when people came and we had a science talk with them. Then after we had yummy Krispy Kremes. That was very very fun. (Lydia)

Allison showed us a new kind of Samoan Circle. It was pretty cool, but we changed a couple of things. (Paula)

I wish you didn't have to leave so soon. It feels like we were just getting started. I guess time flies when your having fun. We'll never forget the year Mr. Horne came to teach us about space!!! (Carol and Libby)

(Written reflections of the space science classroom experience from Mrs. V's 4th grade students, 2004)

Community is a popular word in education today. The term, “learning communities” or “professional learning community (PLC)” (see Dufour, 2004, pp. 6-11) is commonly used to describe any number of different approaches used in school settings to develop a strong learning environment. This may include a plan to build community within the ranks of teachers in a school as part of their professional development efforts or a charge to instill a greater sense of community within the classrooms or school. Rather than defining appropriate professional development activities designed to enhance the school and classroom climate, I choose to lead into this section on community by reflecting on statements written by children about their experience in the classroom community known to them. The children's statements at

the start of this section, selected from many pages of student reflections, are indicative of the tone set forth in the full collection of comments.

Madison “remembered” her opportunity to explain a strongly held belief regarding the moon to a friend and the thrill that comes when someone “FINALLY” understands! Her recollection describes a wonderful student-to-student interaction. Is this an example of community? Does the idea of community help us take the time to understand each other? Trent references my willingness to share personal stories of family while maintaining a connection to the subject matter. Is this what we mean when we say, “community?” In community, do we share personal stories? Sophie comments, “You always make us laugh...” Is this a good illustration of community? Does a community help us laugh together? Lydia’s “vivid memory” describes a time I invited visitors from the University of Maryland to join us for a “science talk.” We shared our knowledge and shared our space with these special visitors. We invited them warmly into our way of “being-in-the-science-class.” Is this community? Paula remembers when Allison showed us all a discussion format she and several classmates invented. Is this indicative of community? In community, do we take time to communicate new ideas? Carol and Libby reflect together on their space science experience. They claim, “We’ll never forget the year...” Is this what community is about? Does the idea of community help us remember the past?

Through their reflections, Mrs. V’s students identified characteristics of their science classroom experience. They inferred that their classroom is a place that

- Allows them to take time to explain and be understood;
- Invites the sharing of personal experiences;
- Encourages laughing together;
- Invites others;

- Communicates new ideas;
- Forms memories.

The brief descriptions of children’s lived experiences begin to reveal the significance of community in the inquiry-based classroom. Through further reflection of student experiences, more insights surface that describe the prevalence of community.

Discovering Community in the Inquiry-Based Classroom

...good teaching is always and essentially communal...but different teachers with different gifts create community in surprisingly different ways. (Palmer, 1998, p. 115)

Palmer makes a powerful claim. But, *is* good teaching essentially communal?

Is building community central to an inquiry-based science classroom? I seek community as I establish myself in the elementary science classroom, but why? Can teaching and learning take place outside of community? How do 4th graders experience community? What is the meaning of community? The *Oxford Dictionary of English Etymology* (1966) defines community as a “body of people associated by common status, pursuits, etc.” (Onions, p. 196). The word community originates from the Latin, *communis*, which is associated with the word common, meaning “belonging equally to two or more” (Onions, p. 195), and the word *commune*, meaning “group of people having a common life” (Onions, p. 196). In a sense, the definition of commune characterizes the elementary classroom. As the teacher establishes community, establishes a common, equally shared physical and emotional space, the group begins to function as a community. A sense of belonging is formed. Common experiences form community. As O’Donohue (1999) says, “The huge longing of the human mind is to discover ever larger shelters of belonging” (p. 94). In essence, these shelters of belonging are “community.”

Certainly not all elementary school experiences can be credited with encouraging community. There are sad examples of classrooms, run more as dictatorships than communities. These are places where the teacher's voice is not just dominant, but is the *only* accepted source of information. The hierarchy in such a setting does not allow for community, but rather, calls for silence, mindless acceptance, or even forced compliance. But, what about the experience of children in an inquiry-based classroom? Does the inquiry-based approach encourage the development of community? The National Science Teachers Association's (NSTA) position statement on "Scientific Inquiry" states:

Regarding the use of scientific inquiry as a teaching approach, NSTA recommends that science teachers...design and manage learning environments that provide students with the time, space, and resources needed for learning science through inquiry. (*National Science Teachers Association* website, 2004)

Here the teacher is called to provide children with time, space, and resources. These are valuable, if not essential, tools required for learning. But, do they require the development of community?

In an inquiry-based classroom, can a teacher provide space while neglecting to establish community? The answer is certainly not an either-or proposition. A given teacher on a given day could encourage or discourage a sense of community – a sense of common, equally shared space. But does the established model of an inquiry-based science classroom challenge the teachers to develop the classroom experience as a community? The NSTA position statement goes on to state:

Regarding students' ability to do scientific inquiry, NSTA recommends that teachers help students...communicate and defend their results to their peers and others. (*National Science Teachers Association* website, 2004)

The empowerment of students to inquire, and then communicate and defend their results with others, suggests a call for community in the inquiry-based classroom.

(1960/1989) writes, “To conduct a conversation means to allow oneself to be conducted by the subject matter to which the partners in the dialogue are oriented. It requires that one does not try to argue the other person down, but that one really considers the weight of the other’s opinion” (p. 367). Both Gadamer and the NSTA position statement offer a sort of description of community that is interactive, engaged, and yet respectful. The voice of students is valued and they are encouraged to share, but even more so, the members of the community are encouraged to listen. The students’ inquiries and their results are given attention and consideration.

As a teacher engaging ten-year-old children in meaningful dialogue in an inquiry-based classroom I ask, “How can I develop this kind of community with my students?” Or, more appropriately, “How can *we* (the students and I) develop a sense of community together?” And for what purpose do we seek to develop community? Wenger (1998) views community as primarily a place of learning. His work, *Communities of Practice*, presents a theory of learning that starts with the assumption that engagement in social practice is the fundamental process by which we learn and become who we are. He states:

Being alive as human beings means that we are constantly engaged in the pursuit of enterprises of all kinds...As we define these enterprises and engage in their pursuit together, we interact with each other and with the world and we tune our relations with each other and with the world accordingly. In other words, we learn. (p. 45)

Through community, we learn! Of course! Community provides the context to cultivate learning. In the inquiry-based classroom we are deliberate in our efforts to

dialogue, to share, to engage in discourse, to remain open to one another in conversation. If our goal is to learn, then our practice must actively engage in a pursuit of community.

Establishing Community through Conversations

Conversations are meant to encourage children to explore, play with and extend what they are just beginning to grasp. More formal talk may not provide these opportunities to the same extent because the child is often intent on giving you responses he or she thinks you want. (Newton, 2002, p. 145)

One morning I ask the students to work with physical models – Styrofoam globes to represent the earth, plastic spheres to represent the moon, and low wattage light bulbs to represent the sun. Before we even touch the models, we recall the beautiful crescent moon seen last evening. Their task is to recreate, with models, the position of the crescent moon, relative to the earth, and sun. I am not expecting “right answers,” especially since this is our first attempt at linking a lived experience, observing the crescent moon, with a representation using physical models. As Hammer and van Zee (2006) remind us, “At some point we want to see them getting right answers, but it’s a matter of judgment when that point comes” (p. 27). The students’ reactions exceed my expectations. They are thinking, wondering, discussing, probing, and even arguing. The room is loud, perhaps too loud by some teachers’ standards. I am grinning from ear to ear. The atmosphere “feels” like inquiry-based science. Amidst the low roar of discussion, my mind drifts to the question van Manen (2003) urges us to ask: “What is the experience like for the child? What is best for the child?” (p. 21). I wonder, “If this is not ‘what is best,’ what could be better?”

As the lesson continues, the buzz of excitement remains tangible. Their conversations are focused. Their body language suggests engagement. They are leaning in, pointing, gesturing, and moving. Some are out of their seats. They are focused on the task, yet they do not demand answers. They are content to manipulate the models, ask questions among themselves, and imagine possibilities. Do these clues begin to answer the question, “What is the experience like?” Can we safely assume that the student reactions this day inform us regarding the question of what is best for the child?

We move from small group exploration with the models to a whole group discussion, a format we refer to as a “Science Talk” modeled after Karen Gallas’ (1995) research. The structure of the talks as we practice them in the day-to-day, is rooted in the heart of the meaning of community or perhaps, commune-ity: “A group of people sharing a common life” (Onions, 1966, p. 196). Our Science Talks look like a typical discussion circle, with no clear leader. As the teacher, I facilitate the discussion, but make a concerted effort to remove myself from the center of the group’s attention. Our discussions are often content related but can also focus on the processes of science, including discussions about inquiry-based science. The students understand that our purpose is to reveal our thinking on a particular topic and to express questions or confusions. At this point, we are no longer just wondering; we are wondering together. As a group that “shares a common life” within the science classroom, we want to understand each other’s perspective. As Gadamer (1960/1989) states,

To reach an understanding in a dialogue is not merely a matter of putting oneself forward and successfully asserting one’s own point of

view, but being transformed into a communion in which we do not remain what we were. (p. 379)

The Science Talk often opens dialogue in such a way as to transform. As we conduct Science Talks we are building a common language, attainable only through such discourse, and as a result, we practice the equal owning or sharing of the intangible space taken up by discourse. This “communion,” as Gadamer terms it, makes common our experience. We develop a shared understanding through our dialogue, but at the same time, we are careful to maintain openness to divergent thinking.

As Gallas (1995) reflects on the process of inviting discussion or discourse into her elementary classroom, she writes:

I was very committed to having children “think out loud” and initiate Science Talks...I learned that what my children were doing as they took over the Science Talks was qualitatively different from what I had orchestrated before the talks. Much to my discomfort, I also learned that there was a subtle difference between a child-centered, developmental classroom, where teacher and children construct (usually in a carefully controlled way) knowledge about the world, and a classroom where that process continues but a focus on discourse is added. (p. 10)

Up to this point, I have used a variety of interchangeable terms to refer to similar actions: talk, “think out loud,” discuss, discourse, dialogue, and discussion. Do they all have essentially the same meaning? What does Gallas mean here by “discourse?” How is *discourse* different from *discussion* or *to discuss*? While the modern definitions of each are quite similar, the early meanings of each word offer further distinction. Discourse, or *discurrere*, originally meant “to run to and fro” (Onions, 1966, p. 272). Contrast this with *discuss*, originally, *discussen*, “to examine, scatter” (*Webster’s New World Dictionary*, 2001, p. 411) or *discutere*, “to dash to pieces, disperse, dispel” (Onions, 1966, p. 273). Discourse, in its early meaning takes on a

more playful tone, suggesting a conversation that takes many twists and turns (to and fro), while discussion's meaning suggests a more formal dialogue designed to examine a topic, challenge an idea, or dispel any uncertainty.

The Science Talk, as Gallas describes it, seems as though it is designed with this ancient meaning of discourse in mind. Science Talks often invite deep thinking on the part of the students as they share openly with the members of the group, while a sense of freedom for the conversation to move “to and fro” is encouraged. Gallas articulates the similarities between the elementary classroom “talks” with the impact of scientific discourse practiced among scientists. She states, “I have learned that the process of scientific discovery is deeply connected to conversation with colleagues, activities that take place both in and out of the laboratory...A scientific idea is often the result of many interpersonal exchanges, of interactions with materials, and of false starts” (Gallas, 1995, p. 14). Likewise, children learn and grow in their knowledge and abilities when they are given permission to exchange ideas, work together, and make mistakes. In other words, they learn and grow when they participate in discourse. The parallels between the community of scientists in the field, and the community of scientific thinkers in the elementary classroom, highlight the potential impact of an inquiry-based approach in the science classroom. An inquiry-based classroom invites community, while at the same time, an effort to develop community in the classroom sets the foundation for inquiry-based science.

As the lesson closes, I call on a student to read the curriculum focus for the day, “Recognize and describe the causes of the repeating patterns of celestial events” (*Maryland State Curriculum*, 2008, p. 10 of 36). Then I pose a simple question:

“What did we learn about this indicator in today’s lesson?” The question opens the possibility for further discourse, for clarification of confusion, for further questions, or for any number of other responses.

In *From Communication to Curriculum*, Barnes (1992) states, “Schools are places where people talk to one another...Nothing could be more obvious” (p. 11). He is here referring to the social nature of school. Taking this notion a step further, nothing seems more obvious to me than the idea that science class is also a place where people should talk to one another. Barnes goes on to say, “When people talk about ‘the school curriculum’ they often mean, ‘what teachers plan in advance for their pupils to learn.’ But a curriculum made only of teachers’ intentions would be an insubstantial thing from which nobody would learn much” (p. 14). The “written curriculum,” then, is merely a starting point. It is the dynamic interaction of children and teacher within a community that breathe life into language of the curriculum. In *Curriculum in a New Key*, Aoki (1993) contrasts the written curriculum, which he calls “curriculum-as-plan” with “the lived curriculum.” He states:

The curriculum-as-plan is the work of curriculum planners ...it is imbued with the planners’ orientations to the world, which inevitable [sic] include their own interests and assumptions about ways of knowing and about how teacher and students are to be understood. (p. 202)

In contrast, he states that “the lived curriculum”

...is really a multiplicity of lived curricula that Miss O and her pupils experience. For Miss O it is a world of face-to-face living with Andrew, with his mop of red hair, who struggles to learn to read...and some 20 others in class, each living out a story of what it is to live school life as Grade 5’s. (Aoki, 1993, p. 203)

The “lived curriculum” is the living, breathing face of the curriculum-as-plan. It is the leap from the theoretical to the practical, the transition from an impersonal and generally stated set of plans, to a dynamic interaction among a community of learners.

As our lesson closes, it is the established, yet unwritten curriculum, the lived curriculum, that allows for the free, open discourse that follows, only to be halted by my all too typical response: “Okay, we are out of time, let’s pick up this conversation tomorrow.” The challenge, of course, is to find the time and space within a busy schedule to actually keep the promise, and revisit the conversation.

A Culture of Conversation, a Community of Truth

The students love the Science Talks. They want to use the format to discuss everything from Social Studies to what food to have at the class party. (May 2005, conversation with Mrs. V)

As our Science Talk begins, Amelia is the first to risk a response. She demonstrates the position and motion of the moon with the model as the class looks on. Aubrey asks, “Does the moon spin?” The question is addressed by a classmate who responds, “I don’t *think* the moon spins.” There is hesitancy in her voice. She seems unsure. Someone else says, “I don’t know!” Mrs. V, who is present and engaged throughout the lesson, calls on a student who shares, “We [someone] must know whether or not the moon spins since astronauts have been there.” Someone else offers the idea that we cannot feel the earth spinning because it spins too slowly. Jared says we have evidence that the moon moves because he has seen it set, just like the sun sets. The conversation continues, taking many twists and turns, as a conversation often does. Later Devon says the moon glows in the dark. A few

children snicker. “Doesn’t it look like it does?” I respond, affirming Devon and hoping to deflect the teasing that might soon follow. Allison says half the moon is lit up all the time. Raquel shares her theory about why the crescent moon looks as it does. Many students speak during the whole group conversation. Many more are very vocal during the small group time. Sometimes the atmosphere in the room during the lesson is subdued, but more often it is loud, student talking over student, small groups competing to hear, the noise level rising dramatically. This level of engagement combined with intense conversation may be what Parker Palmer (1998) would characterize as “a community of truth”:

The community of truth represents knowing quite differently. In the community of truth, as in real life, there are no pristine objects of knowledge and no ultimate authorities. In the community of truth, as in real life, truth does not reside primarily in propositions, and education is more than delivering propositions about objects to passive auditors. In the community of truth, knowing, teaching, and learning look less like General Motors and more like a town meeting, less like a bureaucracy and more like bedlam. (p. 101)

In other words, the community of truth might look to an observer like casual conversation. Or, perhaps it would appear to others as sheer bedlam. Bedlam is defined as, “any place or condition of noise and confusion” (*Webster’s New World Dictionary*, 2001, p. 129). Noise and confusion in the classroom, in the proper amounts and contexts can be both useful and productive though the terms tend to carry negative connotations. It is unfortunate that educators argue endlessly about the perfect learning conditions as if there is some magical mix of freedom and discipline needed to produce positive results or some specific “formula” that will work best all the time. But this discussion moves us away from the lifeworld of children. The essential question of this study is to consider the children’s experiences in the space

science classroom. As van Manen (1991) says, “From a pedagogical perspective, the most important question is always, ‘How does the child experience this particular situation, relationship, or event?’” (p. 11). As I attempt to create a community of truth together with this extraordinary group of children, how do they experience open discussion? How do they respond to “bedlam?” What is the meaning of a “Science Talk” to children? What does community mean to them? Do they recognize community within their classroom?

Thinking that began as wonder has been nourished by community. The students are experiencing a form of community that opens the possibility for inquiry-based science learning. What is a natural outgrowth of community in the elementary science classroom?

Voice in the Inquiry-Based Classroom

I liked when we had our science talks. I liked them because everyone could share their opinion. Also, anyone could disagree or agree with someone’s opinion. (Carol)

I liked how you taught us the Samoan Circle. I liked it because we got to chat with people. Plus everybody had to be quiet. (Trent)

I liked talking to you about things I thought of but was too shy to tell... I liked talking about the things I knew, and sharing them with other people. (Esmerelda)

I love samoan circles. I love them so much, I tried starting one at home, but that didn’t work out too well I might add. (Aubrey)
(Written reflections of the space science classroom experience from Mrs. V’s 4th grade students, 2004)

Too often, teachers talk too much. I am guilty. As teachers, we come to believe that it is our job to talk all day long. Silent pauses during the day are too often filled because we are intimidated by the silence, or perhaps because we think we are

not doing our job if our voice is not frequently giving instructions. Day after day, we fill any void of voice by any means possible. Why, then, do we not allow children the opportunity to fill the void? Children display an overwhelming interest in being heard. They request time to share. They rejoice when given an opportunity to express their thinking. Even the largely silent children will offer appreciation for class time that is less dominated by teacher talk, and more attentive to the voice of class members.

Student voice is integral to an inquiry-based experience. As themes that exemplify the inquiry-based science class experience emerge in my research, each shares a close connection to voice. Students in the inquiry-based classroom value the invitation to **wonder** – a first opportunity to voice their thinking. Likewise, students in the inquiry-based classroom embrace **community**, an outgrowth of relationship building that would not be possible without student expression in one form or another. So, as **voice** emerges as another theme in the inquiry-based classroom, it is important to recognize that there are powerful interrelationships between each of the three themes uncovered thus far. Alone, none would lead to a truly rich inquiry experience. *Inquiry and the National Science Education Standards* (National Research Council, 2000) summarize the essential features of classroom inquiry in five concise statements:

- Learners are engaged by scientifically oriented questions.
- Learners give priority to evidence, which allows them to develop and evaluate explanations that address scientifically oriented questions.
- Learners formulate explanations from evidence to address scientifically oriented questions.

- Learners evaluate their explanations in light of alternative explanations, particularly those reflecting scientific understanding.
- Learners communicate and justify their proposed explanations. (p. 25)

The National Research Council describes a classroom that is student-centered: a place where thinking is encouraged, wonder is promoted, and open dialogue is essential. The inquiry-based classroom offers a community of learners a place to voice their ideas and have them heard. As described by Palmer (1998), too often a different kind of classroom is experienced by our students. He writes, “Behind their fearful silence, our students want to find their voices, speak their voices, have their voices heard” (p. 46). Does the inquiry-based classroom provide the needed structure to invite children to “find their voices?” Beyond “structure,” is it necessary for the teacher “to let them learn” (Heidegger, 1968, p. 15) in the classroom by allowing voice? Palmer (1998) says that “A good teacher is one who can listen to those voices even before they are spoken – so that someday they can speak with truth and confidence” (p. 46). How is voice experienced? Do children experience a rise in confidence through expressing their ideas? What do elementary aged children say about voice?

The Samoan Circle: A Forum for Voice

Desiree: I liked the Samoan Circle.

Mr. Horne: Really?

Desiree: And I liked when we made the sundials and the science talks.

Mr. Horne: And let’s just talk about some of those things...you can pick which one you want to tell me a little bit more about.

Desiree: The Samoan Circle.

Mr. Horne: What about the Samoan Circle?

Desiree: I liked when it let other people talk so you wouldn't get interrupted, and you could tap in if you had something to say and you got to say what you think.
(Conversation with Desiree, a student in Mrs. V's 4th grade class, April 2004)

The structure of the Samoan Circle encourages participants to speak without being interrupted. The topic of discussion can be selected by the teacher, the students, or through a collaborative decision making process. In the inquiry-based science class we often choose to select topics of discussion relevant to the questions and objectives we have been studying. The following description captures the process and intent of the Samoan Circle as I have used it in the elementary classroom setting:

The "Samoan Circle" is a discussion format resembling the community meetings held in American Samoa where members of the community take turns speaking openly while within an inner circle positioned in a public forum while the remainder of the community listens attentively on the outside of the circle and waits for an opportunity to join the inner circle and speak. Samoan circle has people seated in a circle within a circle, however only those in the inner circle are allowed to speak. The inner circle should represent all the different viewpoints present, and all others must remain silent. The process offers others a chance to speak only if they join the 'inner circle'. ...The aim is to stimulate active participation by all parties interested in or affected by an issue, and allows insights into different perspectives on an issue. (*Department of Sustainability and Environment website, 2007*)

In recent years, the Samoan Circle has become a common practice in my day-to-day classroom routine. I first learned of the discussion format from a fellow teacher who heard about it during a workshop presentation. *Amerika Sāmoa: An Anthropological Photo Essay* (1984), states that during community events in American Samoa, "Men, women, and children are allowed to speak and give their opinions..." (Sutter, 1984, p. 50). In the classroom, I attempt to capture the same sense of value given to the speakers in the inner circle. The practice is awkward at

first. Students are not typically comfortable until they have experienced the power of having voice in this kind of setting. After one or two rounds, it is common for someone to ask each day if we can do a Samoan Circle. Written reflections and numerous conversations with children around the theme of the Samoan Circle activity have given me access to the voice of students who have experienced the inner circle:

Inside The Samoan Circle

In the center, all eyes looking.
Who will start the conversation?
Who will stop the silent stare?
Voices speak, language flows,
Inviting thought, encouraging heart.
We share, we question, we listen with care.
(Horne, 2007, reflective writing)

Some may question the value of time spent discussing opinion in a science class. Rather than opinions, perhaps a better way of capturing the intent of the activity is to replace the word “opinion” with the phrase, “current thinking.” As the children make known their current thinking, which is a risk without the development of community, they are given an opportunity to think deeply about a question as scientists do in the adult world. David Hammer and Emily van Zee (2006) refer to the process of articulating one’s current thinking as “shopping for ideas:”

Most...connections children explore are not correct, and so people who are inclined to assess children’s thinking only for correctness might overlook them. The point here is that the shopping itself is important and valuable, even when the children don’t arrive at the answer. That’s actually much more typical of what you’d see a scientist doing, day to day in their research, if you had the chance to watch them: looking for answers but not finding them just yet...So we should learn to recognize children’s shopping for ideas and trying out possibilities as valuable, including when the possibilities don’t turn out to work. (p. 23)

As children participate in the Samoan Circle format to discuss their current thinking around a scientific concept, some magic seems to overtake the group. Time and space for voices and ideas are somehow invited into the classroom. The inner and outer circle of children, interacting respectfully with one another, takes on a unique and inspiring tone. As O'Donohue (1999) says, "The one who dreamed the universe loved circles. There is some strange way in which everything that goes forward is still travelling within the embrace of the circle. Longing and belonging are fused within the circle" (pp. 12-13). The inner circle invites voice – an unspoken longing fulfilled, while the outer circle allows a sense of belonging – a respectful attunement to the voices within.

During a one-on-one conversation with Desiree, a 4th grade student, we talked about things she enjoyed about our science class. Concerning the Samoan Circle, she remarks, "I liked when it let other people talk so you wouldn't get interrupted, and you could tap in if you had something to say and you got to say what you think." Her passion for the Samoan Circle mirrors the emotions of many students.

Year after year I hear and read numerous such statements from 4th grade children. Desiree says, "...you got to say what you think." The question of why it is so important to children to say what they think seems self-evident in light of this comment and so many more just like it. The human spirit desires for their voice to be heard. Palmer states, "If a space is to support learning, it must invite students to find their authentic voices" (Palmer, 1998, p. 75). How does one know an authentic voice? Certainly there is no set method. The *American Heritage Dictionary* defines *authentic* as "having a claimed and verifiable origin or authorship; not counterfeit or

copied; Conforming to fact and therefore worthy of trust, reliance, or belief” (*American Heritage Dictionary On-Line*, 2007). Another meaning, “genuine, real” (*Webster’s New World Dictionary*, 2001, p. 95) implies that an authentic voice can be sincere, or genuine, yet perhaps not scientifically accurate. Ultimately, authentic voices are heard and understood as the community practices thoughtful listening, a willingness to agree or disagree respectfully, and a commitment to question and verify information that is shared with the group so that the collective understanding of the group is deepened.

In *Selfhood and Authenticity*, Anton (2001) writes, “We depend upon particular others to free us for our possibilities, to enable us to become who we are, and they depend on us for their projects and for their self-becoming” (p. 156). In this sense, authenticity requires each student to reveal his/her own thinking for the benefit of the group, not merely reiterating the beliefs of the group. In *Being and Time*, Heidegger alludes to the manipulative impact of the group setting. He states:

We take pleasure and enjoy ourselves as *they* take pleasure; we read, see, and judge about literature and art as *they* see and judge; likewise we shrink back from the ‘great mass’ as *they* shrink back; we find ‘shocking’ what they find shocking. (Heidegger, 1927/1962, pp. 126-127)

Anyone who has experienced a group setting knows how difficult it can be to articulate one’s authentic voice. To speak what is “genuine and real” requires us, first, to know ourselves deeply. This sense of self understanding is embedded in Heidegger’s definition of authenticity. In, *What Does Heidegger Mean by Being in the World?* Hornsby (2008) writes:

Authenticity in Heidegger was grounded in the idea, that absolutely all Dasein is characterized by mimesis. Authentic existence begins from

self-understanding and authentic life is possible if our being-toward-death is resolutely confronted. (p. 2)

Dasein, a term at the core of Heidegger's work, *Being and Time*, literally meaning

being-there, is used to refer to the Being of human beings. Van Manen (2003)

explains *Dasein* as, "a Heideggerian term which refers to that entity or aspect of our humanness which is capable of wondering about its own existence and inquiring into

its own Being" (p. 176). Essential to authenticity is self-knowing. Anton (2001)

summarizes his thinking on authenticity in this way:

As a habit of passionate responsibility, authenticity is the practice of openness by which we are called to fitting responses. Authenticity, therefore, reveals itself as a kind of play: it is an ordered request and a blissfully seduced obedience. More simply addressed, it is a dutiful autonomy, one liberated by indebtedness. (p. 160)

How, then, does a 4th grader achieve an authentic voice? How does the structure of the inquiry-based classroom encourage authentic voice? Does the Samoan Circle provide a space for authenticity? As teachers, are we called to encourage within our students the capacity to develop and express their own authentic voice? Each question focuses on the child as speaker. Expressing one's thoughts is important in the inquiry-based classroom, but voice cannot be considered as a unidirectional act. Without an audience, what purpose does it serve to say something of depth or relevance? How does the act of listening play a part in the inquiry-based science experience?

Listening to Voice

To be present means to participate...thus watching something is a genuine mode of participating. (Gadamer, 1960/1989, p. 124)

What is the experience like for children outside the Samoan circle? The inner circle holds the conversation; however, the remaining students in the class form an outer circle. The outside ring of students is invited to watch and to listen. They are encouraged to share, but they must wait until invited to the inner circle to do so. They are asked to remain silent – respectful – attentive, as they listen and wait. Are those watching from the outside truly participating? Is, as Gadamer suggests, the act of “paying attention” an act of participation?

Nadia writes, “I enjoyed the Samoan Circles and how everyone would have to be absolutely quiet while everybody in the circle was discussing what they learned in science.” “To participate or to take part, as in partake” (Onions, 1966, p. 654), indicates an action – an involvement, a being “part” or a portion of something. Is Nadia a “part” of the conversation that takes place in the inner circle or “apart” from the conversation? As a member of the class, does she see herself as a portion of the group, or as separate from the rest of the community? She says she “enjoyed...how everyone would have to be absolutely quiet.” In what way did she find this enjoyable? Does the “absolute quiet” of the outer circle draw her more fully into the conversation as an active listener? Permission to listen, and the disciplined practice of absolute quiet, seem to invite the outer circle into the conversation, as part of the inner circle. In their silence, students are present. In their listening, they are hearing, they are active, they are participants in all that takes place within the circle. In *The Listening Self*, Levin (1989) paints a beautiful picture of the experience of listening:

In listening to the soundings of nature, listening to the music of sounds, and listening to the speech of others, we learn, we grow, we help others to learn and grow, and we realize that hearing is a gift to be valued and enjoyed. (p. 89)

Does the Samoan Circle activity provide an opportunity for 4th graders to experience the gift of hearing to which Levin refers? Does the experience outside the circle impact the experience in the inquiry-based classroom? Again I ask, “What is the experience like for children outside the Samoan circle?” As I reflect on all I have observed as children participate in the activity, and as I consider what children have said to me in response to their experience inside and outside the circle, I begin to see.

Outside The Samoan Circle

On the outside, looking in,
Wondering, always wondering
Why the voices satisfy so.
In the silence of my tongue
Voices in the circle reflecting mine
While new ideas form and grow.
(Horne, 2007, reflective writing)

Outside of the Samoan Circle is a place that invites a sort of tarrying. Gadamer speaks of tarrying with reference to remaining in the presence of a work of art. To tarry is “to delay, to linger, to be tardy.” Tarry is also defined as, “To stay for a time, especially longer than originally intended” (*Webster’s New World Dictionary*, 2001, p. 1465). The outer group, observing the Samoan circle, is given an unexpected opportunity to linger around a thought or idea. As with the work of art, the onlookers to the Samoan circle are observing, pondering, wondering, and thinking. The participants, in their silence, are given the opportunity to “stay for a time” and consider the meaning and relevance of the observed conversation.

The act of lingering, in this sense, requires attentiveness to the members of the inner circle without categorizing the comments, without immediately formulating a response, without assessing a quick judgment, an act described by Levin (1989) in this way:

...gatherings of sound...are possible only when our listening suspends its normal and habitual judgments – liking and disliking, approving and disapproving, accepting and rejecting... a gathering that comes as a gift to our ears when we have developed the art, the skill of ‘just listening’. It is a gathering that comes only when we let go and let be, letting whatever sounds forth have all the time-space, all the silence, all the openness and otherness of being it wants. (pp. 256-257)

How is the skill of listening acquired? What do 4th graders in the inquiry-based science class hear as they listen? Children desire to have their voices heard. Do they likewise have a desire for opportunities to hear?

Voice Expressed in One-on-one Conversation

I also liked the interview because I got to express my feelings about your lessons, and I got to make connections from my life to your lessons too. (Jon)

The interview was cool. I really liked it because we got to talk alone and I got to find out an answer to a question I had.

(Aggie)

(Written reflections of the space science classroom experience from Mrs. V's 4th grade students, 2004)

Part of the process of inviting voice into the space science classroom is spending time in proximity with children, one-on-one, simply asking them about their experiences. Over lunch one day, my friend and colleague Marilyn and I were discussing this informal process of developing relationships with children through one-on-one conversations. At some point in our conversation she remarks, “You know, spending just five minutes with a child, eye-to-eye, knee-to knee, can change their life – and it *will* certainly change yours.” Hearing this, I was stunned into silent reflection. The meaning and depth of her words poured over me like poetry – such a small set of words striking with hurricane force. By stating, “...it will certainly change you,” Marilyn alludes to the strength of community, the intensity of

relationship, the transforming influence of dialogue. A quote from Gadamer (1960/1989) reinforces this power:

To reach an understanding in a dialogue is not merely a matter of putting oneself forward and successfully asserting one's own point of view, but being transformed into a communion in which we do not remain what we were. (p. 379)

By “not remaining what we were,” we allow ourselves to be impacted by possibilities only a child can show us. Marilyn's statement, built on countless life experiences with children in the classroom, paints such a beautiful picture of the power and pleasure of the teacher-child relationship. Anyone who has experienced these five minutes of time will know the emotion. The time given affects a transition from knowing a person on some surface level to a deeper knowing.

As you look into the innocent eyes of children, they speak to you without words. Though their mouths are silent, in their eyes you can read enthusiasm – like text accentuated with exclamation marks. In your peripheral vision you notice smiles that speak contentment, satisfaction, trust. And sometimes, the eyes are filled, not with delight, but with concern or fear or wonder or confusion or a thousand other emotions, all visible through these windows into the child's heart. Van Manen elaborates:

Children are children because they are in the process of becoming...Life forever questions us about the way it is to be lived. “Is this what I should be doing with my life? Is this how I should spend my time?” No one can reawaken these questions in us more powerfully and more disturbingly than a child. All that is required is that we listen to children, and learn from them. (van Manen, 1986, p. 13)

As I continue to reflect on the everyday occurrence of one-on-one discussions, more emotions emerge as I consider the unmistakable experience shared by so many caring teachers:

Five Minutes with a Child

Eye-to-eye
Knee-to-knee...
Imagine
Possibility.

Eye-to-eye,
Knee-to-knee...
Discover
New thoughts to free.

Eye-to-eye
Knee-to-knee...
Remember
How it used to be.

Eye-to-eye,
Knee-to-knee...
Listen,
Hear sincerity.

Eye-to-eye
Knee-to-knee...
Notice
The strength in we.

Eye-to-eye
Knee-to-knee...
Realize
“It’s not about me.”
(Horne, 2006, reflective writing)

This notion of going eye-to-eye, knee-to-knee with a child is not a technique. It is not a research method; it is part of creating space for learning – an opportunity for voice. It is not just voice for the child – it is the recognition of being together with

each student in the learning process. Again, van Manen (1991) expands on these ideas:

... an emphasis only on the adult's dealings with children neglects the direct and indirect influence that children have on adults, and especially on their parents. Many parents know how powerfully children transform the adults' sense of themselves, their priorities in life, and their preoccupations with the concerns of the world. Many teachers, too, experience the transforming effects young people have on their professional and personal lives. (pp. 11-12)

I can begin to understand and reflect on the transforming effects of my interactions with children in the inquiry-based classroom, but how can I discover the transforming effects experienced by the children in the classroom? What do *they* experience as they go eye-to-eye with the caring teacher?

Voices That Share

... a teaching and learning space must be more than a forum for individual expression. It must also be a place in which the group's voice is gathered and amplified... (Palmer, 1998, p. 75)

Today I come to the classroom with hope. I enter the room with enthusiasm. I brim with passion because I am excited to share photos of the moon I had taken with my digital camera.



(Image 2.4 Horne, 2003, photo shared with students in Mrs. V's class)

The class homework assignment, given at the close of our last lesson, had been to watch for and make observations of the moon and to bring in any space related

resources to share with the class. I choose to demonstrate my enthusiasm for the assignment by participating. I decide to share first, showing with pride and exuberance, the moon photo seen above.

Now, in retrospect, I ask myself, “How did the children experience my presentation? Did they think it was ‘fair’ for the teacher to choose to share first, or is the dominant role of the teacher assumed and accepted?” As I look back, I ask, “Was I merely looking for a ‘forum for personal expression’ as Palmer calls it, or did I have the interests of the community in mind?”

While I was addressing the class, I looked around the room and saw the faces of the students, but I was unable to read their expressions. I was too focused on what I had to share. Later, as I listened to the recording of the lesson I noticed something I did not realize while experiencing the moment. The children had little to say about my sharing and immediately vied for an opportunity to share what *they* had seen and what *they* had brought to share. Does this mean I should not have shared? Voice after voice, sometimes interrupting one another, flooded the room with stories, descriptions, and comments. Rosalie’s grandfather had worked for NASA and written a book. She was bursting with enthusiasm to share this with the class. She wanted everyone to know about her grandfather’s important work. Clearly, she was interested in the approval and interest of the class, as was I, but did she have the best interest of the community in mind? Did I? Did her sharing benefit the rest of the classroom community? What is it like for a student to share? At age 6, Mattie Stepanek speaks to these questions:

God’s favorite language is
Not grown-up’s language,

But the language of Children.
That's because children
Are special to God.
Children know how to share,
And they never lose
Their Heartsongs. (Stepanek, 2001, p. 7)

Questions form in my mind. How is sharing a part of students' being? How has it contributed to their being? What is called forth in sharing? Mattie Stepanek's phrase, "Children know how to share," is powerful and thought provoking. It took me many years to recognize the truth of these words as they apply to the classroom experience. I thought, as the teacher, I knew how best to share – share so well that children could understand and learn. I thought I knew the language of children. And maybe I did, a little. But, at that time, I was not as attuned to the need for community – the importance of sharing the experience of sharing. The more I listen to the voices of children – really listen – the more I am able to turn from my need for personal expression and focus on the power of allowing children to share. The more I am able to practice silence, the better I can hear the meaning, value, and purpose in the words the children share, the questions they ask, and the "songs" they sing.

The word *share* suggests something more than just making a statement. It indicates a giving, a being part of something, an experiencing of something as a group. The origin of *share* sheds deeper meaning: "Share as to cut, divide, or shear" (Onions, 1966, p.817). When children, like Rosalie telling of her grandfather, "share," they aren't just speaking; they are giving – giving away something, cutting, dividing, shearing. They are taking a risk! They are making themselves vulnerable by giving something very personal: their thoughts, their beliefs, their songs. They are allowing others to partake of something they alone possess. They are making a contribution to

the listeners among the class. Their words are not meant merely for their own benefit, but for the common good of the group. Gadamer (1960/1989) reinforces this thought:

We say that we “conduct” a conversation, but the more genuine a conversation is, the less its conduct lies within the will of either partner. Thus a genuine conversation is never the one we wanted to conduct. Rather, it is generally more correct to say that we fall into conversation, or even that we become involved in it. The way one word follows another, with the conversation taking its own twists and reaching its own conclusion, may well be conducted in some way, but the partners conversing are far less the leaders of it than the led. No one knows in advance what will “come out” of a conversation. (p. 383)

Gadamer’s description of genuine conversation illuminates the essence of the adventure that is the heart of an inquiry-based classroom. In every true adventure there is an element of uncertainty. It is this unpredictability that draws a group so compellingly together into conversation. It is the lack of advanced knowledge of what will “come out” of a conversation that motivates young children to plead for opportunities to hold “Science Talks” or circle up for a Samoan Circle discussion. I have experienced a child’s desire to share, but there are still unanswered questions about what children desire to share and why. Such questions compel me to continue the adventure.

Voices that Care

Caring involves stepping out of one’s own personal frame of reference into the other’s. When we care, we consider the other’s point of view, his objective needs, and what he expects of us. (Noddings, 2003, p. 24)

Can an educational setting void of caring still be a learning environment? Or, put another way, is a classroom climate that encourages caring, automatically a place of learning? In the day-to-day experience of the classroom, is sharing words of affirmation a way of caring that pervades the experience? Palmer says, “... groups

must learn to listen to individuals with care” (Palmer, 1998, p. 76). Could this statement also be true of people who speak to individuals with care? Palmer suggests that students do not learn when they are not able to share their “emotions.” What is it like for children to have the space to share their thoughts, their hearts, and their emotions?

One day the students share something unique with me. It is my birthday. Awkwardly, several students approach, and present to me an Altoid tin. “Here, this is for you!” one of them says. A smile spreads across my face. I understand! They know me too well! The tin communicates the connection we have made – a year’s worth of inside jokes, stories, memories. It is filled with tiny well wishes, drawings, notes, and such. Each scrap indicates an intimacy of knowing. To an “outsider” the cherished slips of paper would appear meaningless or perhaps shallow, but I revel in each of them, reading with an understanding not known beyond the community we have built. Their words expose their caring. Berman’s (1991) words regarding schooling as dwelling enlighten the felt emotion:

...if schools were to be seen as places where people dwell compassionately and in communion, more fundamental ways of conceiving schooling might emerge. (p. 187)

Are words of caring such as those shared by the students important to the learning process? Will the time spent sharing words of affirmation impact the students’ hearts and minds? As we interact both compassionately and in communion with one another in the classroom, how might this impact the lived experience of the inquiry-based science class for each child?

A few weeks later, it is time to say goodbye. I am reminded by van Manen (1986) that, "Saying goodbye must be more than mere ritual" (p. 22). He goes on to say, "The value of this practice is that it sets the tone for interpersonal relations" (p. 22). Not too many days from now, my students will be celebrating the freedoms only summer can bring. I begin to wonder about how I can express my sentiments in a caring way. I search for words of affirmation they can carry with them throughout their continued journey. I search for words that will someday help them recall the community we formed, the memories we created, and the space we discovered together. I search for words that might inspire them to listen for their Heartsongs.

With the end of school looming and little time to spare, a forgotten song by Bob Dylan resurfaces in my memory. The song is filled with imagery, power, and purpose. I discover (or rediscover) the "blessing" I wished to pass on to my students. So, as my final gesture of care I print the words to this song on slips of paper, fold them neatly into Altoid tins, and pass one to each child, sending them ahead on their respective journeys along with a personal note I do not share here. Here are the first few lines of the song, *Forever Young* (Dylan, 1974) followed with a verse I composed:

May God bless and keep you always,
May your wishes all come true,
May you always do for others
And let others do for you...
(Bob Dylan, *Planet Waves*, 1974)

May you learn to look closely,
May you listen very deep.
May you ask all of your questions
Though the answers may not keep.
May your heart be filled with wonder,
May you know where you belong,

May you stay forever young,
Forever young, forever young,
May you stay forever young.
(Horne, 2006, reflective writing)

In Nel Noddings' work on caring, she writes of reciprocity. She is careful to point out the complexity of the caring relationship and the necessity to recognize the differences in roles between teachers and their students:

I have claimed that the recognition of caring by the cared-for is necessary to the caring relation. It is clear, however, that the cared-for need not be one-caring in order to constitute the relation. He does not have to receive the one-caring as she receives him. Yet he must respond to her somehow. There is, necessarily, a form of reciprocity in caring. (Noddings, 2003, p. 71)

Will there be any lasting impact from this gesture of caring? Will the messages of encouragement I give to each child, touch the children in the same way their lives have touched me? What is the meaning of caring in the inquiry-based classroom? How is it experienced? On the last day of school Aubrey provides some indication of the impact the relationship we built together had on her heart. She hands me the following note, packaged (of course) in an Altoid tin:

A ton of love
A ton of memories
A ton of sun
A ton of remembrance
A ton of happy

I will remember you!!!
No matter where you R!

My teacher went away this year,
I even cried many tears.
I know I should not cry,
It's not our last good-bye!
If I don't see him again, I fear!

I will certainly miss you and cannot wait

Until I see you next year! As I might not see you
As often, I will still remember you by, even though
I never got your autograph and will see
You with a beard, and goatee, I shall still remember
You as I know you now; Mr. Horne.

(Note from Aubrey, one of Mrs. V's 4th grade students, June 15, 2004)

As I reflect on Aubrey's note, I am reminded of another quote from Parker Palmer, "A learning space should not be filled with abstractions so bloated that no room remains for the small but soulful realities that grow in our students' lives" (1998, p. 76). Through the year-long process of expressing **wonder**, building **community** in the classroom, and expressing **voice**, we shared important discussions of educational significance as we pondered the cosmos together and posed question upon question regarding the wonders of the night sky. And yet, we also shared light moments of fun and laughter with seemingly insignificant connections to the content of our study. I wonder what lasting impact this kind of experience has on the other? Of what significance were the countless words of caring traded to and fro in the inquiry-based experience? What is the role of caring during inquiry-based science?

Giving Children Space in the Inquiry-Based Classroom

Giving children space requires a commitment to surrendering some control in the classroom. Giving space means giving up something. Perhaps something held very dear, like a need for control, or simply an old habit or old belief that has become automatic. (Horne, 2007a, p. 108)

At a Space Day event in Washington D.C., a commemorative T-shirt was handed to each of us. The clever statement incorporated into the shirt design, "Gimme Some Space!" was written by several elementary school students as part of a Space Day design contest. Is the plea for space merely a humorous play on words, or could there be a deeper meaning implied? What does it mean to be given space? Do

children want space in the classroom? If so, what kind of space are they seeking? As themes emerge, it is apparent that students in the inquiry-based classroom value the invitation to wonder, they gravitate toward community, and they openly embrace opportunities to express voice. How are these themes related to a call for space?

Obviously there are many shades of meaning for the word space. *Webster's Unabridged Encyclopedic Dictionary of the English Language* (2001) identifies 24 varying definitions for space. One meaning conjures images of planets, stars, telescopes, and astronauts. In this context, space is defined as, "Of, pertaining to, or concerned with outer space or deep space" (p. 1827). The topic of outer space is highly engaging for many children, and as part of the *Maryland State Curriculum*, it is also a required topic of study at the elementary school level in my district. In a standards-based era, specific content becomes an important focus. As such, it is important to find ways to engage students in the study of space content. But, when children express the sentiment, "Gimme some space," it is not merely content information they seek. The plea suggests a need for something more. Toward who is the appeal directed? What other kinds of space do elementary students seek? Who has authority to grant space? Additional definitions of space may suggest answers to these questions. Other meanings for space include: "Freedom or opportunity to express oneself; Allowance, understanding, or non-interference; Linear distance; A particular extent of time" (*Webster's Unabridged Encyclopedic Dictionary of the English Language*, 2001, p. 1827).

These definitions open possibilities for insight, but also reveal new questions. How do children experience space as freedom? When children ask for space, are they

hoping for non-interference? Do children also seek physical, linear space? What is the meaning of time in the elementary classroom?

As I have described children's lived experiences in the inquiry-based space science classroom, and reflected on them, "ways of being" fundamental to the child's experience have come to light. Themes such as wonder, community, and voice have presented themselves. Certainly more themes still lie in wait, resting in shadow. But from the outset of this study, the theme of "giving children space" has been at the forefront of my thinking. My assumption has been, "Of course children need space!" But, how can I look more closely at the inquiry-based experience to identify the various kinds of space children need? Of the many shaded meanings of the phrase, "giving children space," how can my inquiry reveal the kinds of spaces children experience? In *Space and Place*, Tuan (1977) reflects on space as in spaciousness:

Consider space. As a geometrical unit (area or volume), it is a measurable and unambiguous quantity. More loosely speaking, space means room ... room can mean more than physical space; it suggest spaciousness... Spaciousness is closely associated with the sense of being free. Freedom implies space; it means having the power and enough room in which to act. (pp. 51-52)

Tuan touches on physical space as a means to freedom, but the sense of interconnectedness between space, spaciousness, and freedom can easily be related to emotional space, mental space, and even time-space. As children experience the inquiry-based classroom, they will inevitably experience varying amounts of space, varying kinds of space, and express varying needs for each. The question, then, is not about whether or not space is given, how much space is provided, or what kind of space is optimum. Rather, I must remain steadfast in observing and describing how

children experience the inquiry-based classroom as the teacher gives them space in all of its shades of meaning.

In *Researching Lived Experience*, Max van Manen (2003) describes a way of looking at lived experience that is beneficial here. He states, “The four fundamental existentials of spatiality, corporeality, temporality, and relationality may be seen to belong to the existential ground by way of which all human beings experience the world, although not all in the same modality of course” (p. 102). According to van Manen, “They all form an intricate unity which we call the lifeworld – our lived world” (p. 105).

In what manner do children live in these existentials that make up their lifeworld? When they leave the classroom and, as part of a class assignment, gaze into the night sky, what do they experience? As they look into the vastness of space, what kind of space do they sense? What is the experience of time like as they look into the night sky? What is it like to bodily experience a night under the stars? What will children experience relationally when they join others to view the night sky? What is the lived meaning of experiencing the night sky? Perhaps the existentials can help us through such inquiries.

Giving Children Space as They Experience Lived Space (Spatiality)

Looking up into the vastness of space,
Discovering space.
(Horne, 2006, reflective writing, *Gazing into the Night Sky*)

Van Manen (2003) says that “Lived space (spatiality) is felt space” (p. 102). What does the space experienced in the inquiry-based classroom feel like? One way of experiencing space, or spatiality, in the inquiry-based classroom is to move the experience beyond the four walls of the room. At times the physical space in the room

is inadequate to demonstrate a concept or principle, so in order to describe space, more space is required. Matt, one of the students in Mrs. V's class reflects, "I liked when we went outside and did relative distances with the models. I liked it because we got to go outside."

During the activity we use scale models to demonstrate in a greater sense, the size of the solar system. A playground ball, used to represent the sun, is placed in the middle of a field in back of the school. An accurate scale model earth (relative to the playground ball), a single BB (a small metal sphere about 3mm across) is held 81 feet from the sun model. The whole class walks around the sun model, counter-clockwise, maintaining a distance of 81 feet from the playground ball. The "walk" gives a greater sense of the physical distance the earth travels around the sun each year. Later Desiree comments, "Now I know why it takes a whole year for the earth to go around the sun!" implying that the great distance we walked around the playground ball put the concept of one-year into perspective. And that is the purpose of the activity, but how does a child experience concepts such as space and time? Matt remembers the activity because, as he states, "we got to go outside," but what aspect of the activity is memorable? Taun (1977) reminds us that, "Even to an older child, the moon overhead is easily considered a different object from the moon on the horizon. That the moon moves around the earth is an abstraction alien to the child's experience" (p. 22). How does the outdoor environment impact the learning experience? How does the experience of making observations of the earth and sky impact a child's understanding? Can a direct observation of the observable moon make understandable that which was alien?

With regard to experiencing seasons, the *Benchmarks for Science Literacy* (American Association for the Advancement of Science, 1993) states: “In trying to understand the seasons, students have difficulties regarding geometry and solar radiation. Students need direct experience with light and surfaces – shadows and reflections, and warming effects at different angles” (p. 66). How can a child in the space science classroom learn about concepts of space without experiencing space firsthand? Can space be understood without seeing the moon in the sky, experiencing the heat of the sun, noting the length of our shadows?

In describing how we experience the world outside Casey (1993) writes:

But we need not have recourse to cosmology to realize how powerfully structuring the earth-sky dimension can be. We need only step outside and look around. What do we see? At the very least, we see some aspect of the earth and catch some glimpse of the sky...things on the ground around us and underfoot that, in their comparative solidity, distinguish themselves from the ethereal entities of the atmospheric upper world. (p. 207)

Why does Matt like being outside? What is the experience like? Is this the place that gives him space to wonder? Does the space allow him to experience the world in a way that provides a powerful learning environment?

Adelle, another student in the class reflecting on her experiences in the inquiry-based classroom, remarks, “Looking through the telescope to see the moon was awesome!” What was awesome about the experience? Was it the novelty of seeing a familiar object with amazing clarity and detail? How was this experience illuminating to her? As Casey (1993) describes the human experience of observing surface and texture, I am inclined to wonder. He writes:

The *sensuous surface* is an aspect of the surrounding array that stands out in our first encounter with a particular wild place. The surface is

the moment of impingement, what my sensing body first notices. The “local character” of a wild place is conveyed to us by the sensuous qualities of the surfaces it turns toward us. The sensuous qualities themselves are of many sorts – as many as our own sensory systems, working singly or together, can apprehend. They include classically determined primary and secondary qualities, such as motion, shape, and color, as well as such less familiar variables as density, luminosity, and especially texture. (p. 209)

Adelle experiences the moon, its beautiful features, its texture, for the very first time.

Now the object of our study transforms from a distant, far removed object to a real and reachable place. It is a place that can be experienced, visually at least. Her reaction? “Awesome!” But what else can I discover of the 4th grader’s experience of the moon as a place removed from us by a vast space? As we experience the space science classroom, the outdoors, and even observations that offer space beyond our experience of earth and sky, what is this like for the child?

In her reflection, Carol writes, “I remember learning about a constellation, learning its name, when it’s out...then I would go out at night and look for it.” What started in the classroom as an idea about a unique blend of space and place, led Carol to search the open spaces of the night sky. The day after we discussed *Orion the Hunter* in class, at least half a dozen students greeted me with excitement about finding the beautiful object in the chilly night sky. The classroom space extended beyond the physical space of the classroom and even beyond the reaches of the school-yard. The students took their interest and excitement home and shared this enthusiasm with others. They experienced, at home, what could not be fully experienced in the sun filled sky of the school playground. What is the lived meaning of this shift of the learning space (or place) to the home? What is the meaning of home to a child? In *Looking for Home: A Phenomenological Study of Home in the*

Classroom, Sinclair (1994) writes, “Home is defined in different ways depending on who we are; though what we all have in common in our personal definition of home is the familiarity and intimacy found in relationships” (p. 10). A child “at home” in the classroom space finds a comfort that transcends physical space, is not entirely dependent on place, and can experience intimacy without regard to the surroundings.

Van Manen (2003) states: “Home is where we can *be what we are*” (p. 102). How do children experience feelings of “home” within the inquiry-based classroom? Being “what we are” can open space, even limited space, to feel expansive, to allow for movement, to give the sensation of openness. The experience of home can be physical, but it can also be experienced in many other ways. Sinclair (1994) says, “Home... is that which provides us with the sense of communion with others that helps the individual self emerge. Home helps us become conscious of the world around ourselves and establish an identity with others” (p. 10). How does the experience in the inquiry-based classroom, the physical space outside the classroom, and even the impact of the experience that travels home on the bus and influences a child’s actions beyond the school-day, open children to experience communion with others and consciousness of the world around them?

Finding Another Kind of Lived Space (Spatiality)

Imagine for a moment there is no moon orbiting our earth each month. What would life on earth be like? How would our experience be different? In other words, “What if there was no moon? The simple, yet thought provoking “what if...” question has led to many animated discussions in the 4th grade space science classroom. This day was no exception. The rationale underlying the activity is to engage students in

inquiry-based science. We are not likely to develop a thorough (or even correct) answer in a day – but perhaps we will hone our skills as thinkers. Perhaps we will engage in an experience that will move us beyond the classroom setting – physically and mentally. Perhaps the relevant phenomenological question, “What is it like for children to experience this kind of inquiry-based activity?” is more difficult to answer. Fortunately Aubrey came forward and offered insight.

The following day, she greets me: excited, enthusiastic, and determined. She informs me that she was up much of the night wondering. She says, “After our lesson on ‘What if there was no moon’ I got to wondering about what the world would be like if there were no sun. Just the thought of it kept me awake most of the night thinking about all the possibilities. I just lay in my bed and thought and thought.”

Aubrey reveals something of her heart. The “What if...” activity connected with her in a meaningful way. Outside of the four walls of the classroom, she was thinking like a scientist – a desired outcome of inquiry-based science. Her thoughts were incomplete, however, a valuable aspect of her experience is found in her thinking. As Hammer and van Zee (2006) point out, “Important progress happens when someone thinks of a connection that isn’t obvious, and it works, but that means good scientists try out lots of connections that don’t turn out to work” (p. 23).

Aubrey was engaged in thinking that moved the simple inquiry lesson beyond the walls of the classroom. Her thinking was without conclusion; yet, the lesson touched her heart in a way that impacted her imagination and caused her to think deeply and seek understanding. In *Back to the Basics of Teaching and Learning*, the authors state:

The world of learning shrinks, for far too many, to the size of an 8 ½ by 11 piece of paper. What understandings they manage to develop are frequently meager and threadbare. (Jardine, Clifford, & Friesen, 2003, p. 93)

What kind of space has Aubrey experienced? The physicality of the 8 ½ by 11 paper serves as a wonderful metaphor for physical space. All sense of openness and freedom are confined by the image of the sheet of paper. The margins become walls, closing in – restricting movement. But how does Aubrey experience physical space in this context?

In *Place and Space* Taun (2003) distinguishes between spaciousness as physical size and spaciousness as psychological and spiritual qualities. The physical space experienced by Aubrey was that of a typical classroom, not exceedingly large, not cramped or uncomfortably restricting in a physical sense. Yet, the space she experienced in her mind and heart was broad – open – extensive – beyond the physical limitations of the classroom wall. Space, can be described as distance or spaciousness between bodies, either real or imagined, but what is the experience like, bodily, as children encounter the space science classroom?

Giving Children Space as They Experience Lived Body (Corporeality)

Turning away from self,
Experiencing self-discovery.
(Horne, 2006, reflective writing, *Gazing into the Night Sky*)

Van Manen (2003) states that lived body (corporeality) “refers to the phenomenological fact that we are always bodily in the world...In our physical or bodily presence we both reveal something about ourselves and we always conceal something at the same time – not necessarily consciously or deliberately, but rather in spite of ourselves” (p. 103) What does the space science experience feel like in the

inquiry-based classroom? What do children sense, bodily, as they enter the classroom, as they engage in hands-on experiences, and as they continue their inquiries beyond the school day, gazing into the night sky?

The bodily experiences surrounding the inquiry-based classroom are multifaceted. I sometimes take for granted that children will feel comfortable interacting in an active group setting. It is just not always true! The issue is not simply related to group size, or the organization of the room, but to the many factors that can change from moment to moment. What kind of space will provide children with the security they need to feel at ease, safe, and relaxed? What are the students telling me about their experiences that will inform my actions? I listen, I try to give them space, and I ask. Sometimes the answers come.

Desiree: The Samoan circle. One thing I don't like about it is...when you're talking is tat tat tat [Firmly taps herself on the arm three times].

Madison: Yeah, really, they're always like, [slaps herself on the arm] they're always like zooming in.

Allison: Sometimes they pinch you too!

Desiree: One time, one time, A boy was sitting near me named Ryan and he went up and he fell because everyone was crowding him and he fell – like nobody could catch him.

(Conversation with students in Mrs.V's 4th grade class, April 2004)

Children are looking for a safe place emotionally, but even more fundamental, is a space where they can feel physically safe. If they are physically threatened, they are not in a learning space. As the children speak of their concerns, I sense within me a growing desire to intervene. How seriously should I take their concerns? Is the threat big enough to limit the children's thinking? What can I do to help the situation? As the children continue to discuss their bodily experience in the Samoan Circle, I recognize that by merely listening I am helping; I am giving them space to be heard.

As they speak, part of me wants to act, to react. But instead, I wait, I listen, I pause. As the conversation continues, a wonderful thing begins to happen! Through our discourse, solutions are formulated. What had been “concealed” is now revealed, and the group of students expresses ways to provide a more workable format for the Samoan Circle. Not once did the students suggest we retreat back to more of a passive solution. The classroom experience they press for is active, engaging, interactive, and loud, but also respectful of others’ personal physical space. In *Inquiry and the National Science Education Standards* (2000), the National Research Council states:

Students do not come to understand inquiry simply by learning words such as “hypothesis” and “inference” or by memorizing procedures such as “the steps of the scientific method.” They must experience inquiry directly to gain a deep understanding of its characteristics. (p. 14)

What does it mean for students to “...experience inquiry directly” (National Research Council, 2000, p. 14). I ask with profound interest and respect: What is the bodily experience like for the child to engage in the process of inquiry? How would the meaning of the experience change in a classroom devoid of movement? An experience outside the classroom presented questions about the impact of direct experiences.

Mrs. V’s Space Day Design Challenge students have worked hard all year and were one of 18 teams selected among hundreds as winners in an international competition. The children are seated in the front row in a huge auditorium at the National Air and Space Museum Steven F. Udvar-Hazy Center. Dignitaries have not yet arrived, but Tanya is seated next to an empty chair with the name “John Glenn” attached to it. There is a buzz among the children. “John Glenn’s seat is *right* next to

Tanya's! Wow, he's famous! He's a real astronaut!" How will the experience of sitting so close to someone famous impact Tanya? What will she feel? How will she react? In what way might this experience touch her?

We had spoken of John Glenn's famous flight around the earth in *Friendship 7*, the historical event that occurred over forty years ago on February 20, 1962 (Glenn, 1999). What the children do not know, nor have they considered, is the lived childhood experience that most directly impacted the path of this astronaut's life. During the summer John Glenn turned eight years old his Dad invited him along on a plumbing job. On the way home they spotted a small plane in a farmer's field and stopped for a closer look. The pilot of the plane was offering rides for a fee. To John Glenn's astonishment, his Dad made arrangements for them to go up! Reflecting on the event, Glenn writes:

As we drove home, Dad asked me if I'd liked the flight. I told him that I had. He said he had too...I was hooked on flying after that, on the idea of swooping and soaring. Riding in the car with Dad on a warm day, I would hold my hand out the car window and curve it into the wind. Or I would lean out with my little tin toy airplane and watch the propeller whirl around. (Glenn, 1999, p. 11)

Was this a defining moment in John Glenn's life? How different might his life have been without this lived experience? Did this event impact his life in a way that profoundly determined his life path? There is no way to know for certain. I can sense that the children I am privileged to join this day are experiencing something special, something unique. I am honored to be a small part of that experience. I wonder how this experience will impact each of their life paths. I wonder how this moment will play into their life story. How different would the experience be for John Glenn had he merely "learned" about flying in a classroom? What was the experience

like for Tanya as John Glenn sat down beside her? What was the experience like for John Glenn? In what way do the lived bodily experiences in which we engage impact our understanding, our plans, our very lives?

Giving Children Space as They Experience Lived Time (Temporality)

Taking time,
Unlocking eternity.
(Horne, 2006, reflective writing, *Gazing into the Night Sky*)

Van Manen (2003) says that “Lived time (temporality) is subjective time as opposed to clock time or objective time. Lived time is the time that appears to speed up when we enjoy ourselves and slow down when we feel bored as in an uninteresting lecture or when we are anxious, as in the dentist’s chair” (p. 104). What does time as experienced in the inquiry-based classroom feel like? How do children experience time? Gadamer (1960/1989) describes an experience that moves us outside an awareness of the passage of time. He writes:

In fact, being outside of oneself is the positive possibility of being wholly with something else. This kind of being present is a self-forgetfulness, and to be a spectator consists in giving oneself in self-forgetfulness to what one is watching. (p. 126)

Do elementary-aged students experience a “self-forgetfulness” during their school experiences? Does time ever appear to stand still? Does time stand as a barrier to children’s experiences throughout the school day? How do they perceive the limitations time places upon them?

I am visiting Mrs. V’s class at the end of the day to touch base and pick some dates for future visits. Brendan approaches me, greets me warmly, and asks if I like Uno® (a card game). Startled he would be so friendly and thrilled with his invitation, a smile spontaneously forms on my face. I am honored! Of course the answer is yes!

But Mrs. V reminds Brendan that he does not have time for games: his bus will be called “any minute now” and he needs to be listening for the announcement. My heart sinks and my countenance drops. I feel like a kid again, that terrible sensation when one is called in to do homework on a beautiful sunny day! I sense that Brendan feels the same way. I tell him we will have to make it another time. A faint spark returns as he agrees to the invitation. The rest of the evening I cannot get the experience off my mind. What a great kid! What a wonderful gesture! How did I let such an opportunity slip past? With busy days and hectic schedules, when will I find a time to play a game with Brendan? Maybe I blew it, but what could I have done? How can I make space for time? How can I not make space for time?

These questions are borne out of an opportunity lost. I cannot ask Brendan to reflect on the experience of playing Uno® because the experience never materialized. The lost opportunity serves a purpose – reflection on this seemingly tangential event has highlighted the question of time or temporality. What activities must I make a priority given a limited amount of time? Are there experiences that seemingly extend the time allotted? Is it possible to create additional time in a fixed schedule? In *A Watched Pot*, Flaherty (1999) gives insight:

It may be that, unlike their jaded elders, time seems to pass slowly for young people simply because so much of their experience is new, striking, and memorable; in short, there is more novelty in their lives, with its attendant effects on the perceived passage of time. (p. 79)

The characterization of the inquiry-based classroom as novel is consistent with children’s comments. Students repeatedly remark on differences between the science class experience and other subjects. The novel aspects of the inquiry-based experience include: opportunities to discuss ideas, time allotted to thinking out-loud,

and priority given to allow students to share insights. The novelty of the hands-on, minds-on nature of the inquiry-based classroom experience is notable. During a small group conversation, Allison, one of Mrs. V's students, comments, "Social Studies is one of the non-talking subjects." Madison adds, "There's not really that much to discuss and if there is, then Mrs. J, well she never would really make us talk about what we think should have happened. Mainly we write about it." To a 4th grade student, is time spent writing perceived much differently than time spent discussing, moving, manipulating models, or wondering? Is perception of the passage of time influenced by novelty alone? What other factors influence the child's perception of time?

While my questions regarding student experiences relative to temporality are abundant and largely unanswered, there is a clear and undeniable demand for time devoted to elementary science instruction if a truly inquiry-based approach is to be sustained. In the seminal work, *Science for All Americans*, Rutherford and Ahlgren (1990) make a plea for change in schools for the sake of scientific literacy in America. They write:

In learning science, students need time for exploring, for making observations, for taking wrong turns, for testing ideas, for doing things over again... Moreover, any topic in science, mathematics, or technology that is taught only in a single lesson or unit is unlikely to leave a trace by the end of schooling. (p. 193)

What is called for here? Time. How much time is actually provided? Allotted time for science varies from district to district. In my district, 40 minutes a day is set aside for science one-half of the school year (90 days); the other half is devoted to social studies. This amounts to 60 hours of classroom time per school year. Spread over the

course of an entire year, this would equate to an average of about 10 minutes of science a day. Given the paucity of time devoted to science instruction, combined with the necessity of time needed to impact understanding, the importance of revealing the lived experience of children in the inquiry-based classroom is clear.

Giving Children Space as They Experience Lived Other (Relationality)

Connecting the dots,
Knowing you are not alone.
(Horne, 2006, reflective writing, *Gazing into the Night Sky*)

Van Manen (2003) says that “Lived other (relationality) is the lived relation we maintain with others in the interpersonal space that we share with them” (p. 104). What is relationality, as experienced in the inquiry-based classroom, like for elementary-aged students? Gadamer (1960/1989) reminds us, “It is clear that the life-world is always at the same time a communal world that involves being with other people as well” (p. 247). Desiree describes the communal nature of the inquiry-based science class: “Sometimes we get into groups. Math and science you ... raise your hand and call out answers. Science you have to like discuss a process. That’s why math and science class are a little bit louder than reading and social studies and language arts.” In fact, many of the conversations I held with children are infused with comments suggesting relationality. Notice their language here (bold for emphasis):

- **We** went outside and did relative distances with the models. (Matt)
- It was fun when **we** did the science talks. It was fun because **one person** would come up with a conclusion and **then another** one would and it would become a huge argument. (Jon)
- **Everybody** could speak their opinions and none of the teachers said anything so it [was] all a **kid’s conversation**. (Bradley)
- **You and I** talking about science. (Libby)

- **We** would always say, “NOTHING!” after someone asked what **we** learned because there’s mostly nothing in space... (Shanetta)
- I think the samoan circle was fun because **we each** got to take turns talking. **We** were taking turns telling what **we** think. (Tanya) (Mrs. V’s 4th grade students, 2004)

A special lived relation is experienced in our classroom community. Through time and space, community and conversation, experiences are made possible that could not have occurred at the outset of the school year. Van Manen (2003) notes, “In this lived relation the child experiences a fundamental sense of support and security that ultimately allows him or her to become a mature and independent person” (p. 106). Within our classroom community, Madison, Allison, and Desiree worked together one day to solve a problem we were experiencing with the much loved Samoan Circle activity. Students were becoming too aggressive in their desire to be a part of the inner circle. Rather than dismissing the concerns or abandoning the activity, these 4th graders put their heads together in search of a solution. Throughout the conversation they formed the beginnings of a plan. Later in the conversation I was able to witness the birth of a new strategy, a true team effort!

Desiree: I like the idea of the science talks and the Samoan circle combined.[*Madison joins in and says, “Samoan circle combined” simultaneously with Desiree.*]

Madison: That is so cool!

Mr. Horne: Well, for sure, I think we should try one before the year’s out.

Desiree: Yeah!

Mr. Horne: Try out your idea, share it with the whole class and see how it goes.

Desiree: Yeah, we could like tell the directions.

Mr. Horne: That’d be cool.

Madison: Okay!

Desiree: Okay!

Mr. Horne: Tell them you invented a new id-, a new strategy and we’re going to test it out and you can explain how it works and you can be the first ones in the middle.

Madison: We'll call it D-M-A, no A no M.
 Allison: D-M-A, D-N-A.
 Madison: D-M...M-A-D [*pointing to herself for M, Allison for A, and Desiree for D*] Mad! M-A-D, M-A-D, mad!
 Desiree: Or the D-M-A.
 Madison: D-M-A.
 Desiree: Oh, we're getting off track.
 Madison: M-A-D.
 Allison: Shhhhh!
 Desiree: Okay, it's called the mad—
 Mr. Horne: —All right, what, now that stands for?
 Madison: Madison, Allison, Desiree [*All laughing*].
 Mr. Horne: Oh! [*Laughing*] – the MAD strategy, yeah okay!
 (Mrs. V's 4th grade students, 2004)

The “MAD strategy” is born, and aptly named! The girls are thrilled! They are “mothers” to a new idea. The excitement in the room is palpable! More than just an idea, they created a solution! I gave them time and the time gave them power, power to address concerns and power to fix problems. I am honored to witness such a display of passion. Children thrive when given room to flex their minds, work out problems, and think for themselves. At this moment I am convinced there is nothing these children cannot accomplish – with a little time (and space)!

Reflection on Experiences Gives Rise to Memory

Reflecting on classroom experiences opens my mind to deeper levels of insight and inspires further inquiry into the lived meaning of experience. Spending an hour with Madison, Allison, and Desiree that afternoon was inspiring. But, what if I never gave it another thought? What if I did not seek the time and space necessary to consider the meaning of their interactions? The thought of the “MAD strategy” girls laughing and talking and planning remind me of carefree days I experienced so long ago. Lost in thought and seemingly out of nowhere I remember a childhood experience. I begin to write:

Gazing Into the Night Sky

Looking up into the vastness of space,
Discovering space.

Turning away from self,
Experiencing self-discovery.

In the presence of beauty,
Sensing warmth.

Taking time,
Unlocking eternity.

Connecting the dots,
Knowing you are not alone.

Together remaining silent,
Hearing the songs of your hearts.
(Horne, 2006, reflective writing)

The childhood memory of gazing into the night sky is packed with meaning.

The lived experience was a time of awakening. It is the first time I recall being drawn to the sky as a source of, not only beauty, but unanswered questions. Leaning against our parked car (a maroon station wagon) in my neighborhood of look-alike houses, I still remember the smells of summer: the warmth of the metal at my back, the sense of being with another, and even the questions that formed in my mind. “How far does space go? Where does it end? What is at the end?” Those were my questions then. My friend, Peter, and I talked about it under the darkening sky. We wondered together. We stared upwards. We laughed. We had no answers and we did not care. What was it we experienced that night? Could it have been space?

Looking Ahead

The heart of my inquiry is to know what the experience is like for the children. As van Manen (2003) states: “From a phenomenological point of view, to

do research is always to question the way we experience the world, to want to know the world in which we live as human beings” (p. 5).

In Chapter Three, I use the initial themes described here in Chapter Two as a prism through which to explore the philosophical grounding and the methodology of hermeneutic phenomenological inquiry as it applies to my essential question: **What is the lived experience of 4th grade students engaged in the process of space science inquiry?**

CHAPTER THREE:

PHILOSOPHICAL FOUNDINGS AND METHODOLOGY FOR HERMENEUTIC PHENOMENOLOGY

What is phenomenology? It may seem strange that this question has still to be asked half a century after the first works of Husserl. The fact remains that it has by no means been answered. Phenomenology is the study of essences; and according to it, all problems amount to finding definitions of essences... But phenomenology is also a philosophy that puts essences back into existence. (Merleau-Ponty, 1945/2002, p. vii)

Essence comes from the Latin *essentia*, meaning “to be... something that is, or exists; entity... that which makes something what it is; intrinsic, fundamental nature or most important quality (of something); essential being” (*Webster’s New World Dictionary*, 2001, p. 486). Closely related, *Essential* means, “of or constituting the intrinsic, fundamental nature of something; basic; inherent; absolutely necessary; indispensable; requisite” (*Webster’s New World Dictionary*, 2001, p. 486).

According to *Webster’s Encyclopedic Unabridged Dictionary of the English Language* (2001), the word *essence* can also refer to “a substance obtained from a plant, drug, or the like containing its characteristic qualities in concentrated form” (p. 662). Similarly, the term can refer to “a perfume or scent” (p. 662). Such definitions suggest something not immediately apparent, something that requires a process to uncover, and yet perhaps something beautiful, pure, or costly. In O’Donohue’s *Beauty: The Invisible Embrace*, he remarks:

I love the word ‘essence’. It has mystery, heart, and luminosity. It reminds me of the way a cloud can open over a dark Conamara lake and turn it into a shimmering mirror of silver brightness. For a few moments the lake illuminates. The essence of a thing is always elusive and hidden. (p. 171)

Just as *essence* as in scent is sometimes subtle, hidden, or elusive, so too, the essence of a thing, especially a person, can be mysterious. Mattie Stepanek used the word “Heartsong” in his poetry to substitute for essence and encourages each of us to seek our own essence. In *Messenger*, Jeni Stepanek (2009) further explains her son’s message:

“Heartsong” became a word he coined for himself to get to a person’s essence – the longings and hopes and feelings that both describe and stir each of us. (pp. 23-24)

Heartsong indicates the essential, the core, the things that matter most in our being. Van Manen says, “...phenomenological research...aims at elucidating those phenomenologically structural features of a phenomenon that help to make visible, as it were, that which constitutes the nature or essence of the phenomenon” (van Manen, 2003, pp. 121-122). The journey of the phenomenological researcher is to uncover the essential, or rather, the essence of a thing and then tell about it. Heidegger elaborates:

What is it that phenomenology is to “let us see”? What is it that must be called a “phenomenon” in a distinctive sense? What is it that by its very essence is *necessarily* the theme whenever we exhibit something *explicitly*? Manifestly, it is something that proximally and for the most part does not show itself at all: it is something that lies *hidden*, in contrast to that which proximally and for the most part does show itself; but at the same time it is something that belongs to what thus shows itself, and it belongs to it so essentially as to constitute its meaning and its ground. (1927/1962, p. 59)

The origin of my essential question: **What is the lived experience of 4th grade students engaged in the process of space science inquiry?** is rooted in my own experience of space science as a child, living through the era of the Mercury, Gemini, and Apollo space programs coupled with my childhood experience of

receiving space to explore, wonder, and discover. Through the process of writing and re-writing Chapter Two, reflections on lived experiences with children in the inquiry-based space science classroom unveiled initial themes of *wonder*, *community*, *voice*, and, at the core of my inquiry, *space*. These themes provide essences, or essential elements, to continue to seek and to uncover “what lies hidden” through the process of phenomenological research.

The work of phenomenological philosophers such as Hans-Georg Gadamer and Martin Heidegger serve as consultants or guides for my journey as I continue to uncover the essential understandings I seek. To find my way through the complex twists and turns and confusing intersections of understanding, I recognize the need for guidance and direction. The metaphor of being on a journey hints at the need for some kind of map. What would this map look like? John Eldredge (2006) offers insight here:

The pleasure of a map is that it gives you the lay of the land, and yet you still have to make choices about how you will cover the terrain before you. A map is a guide, not a formula. It offers freedom. (p. xi)

What kind of terrain have I encountered thus far? In what way do my experiences inform me as I continue along? If I am to find guidance while experiencing the freedom that comes from making choices, I will need to pay close attention to where I have been, while being mindful of where I am going. My consultants (the philosophers) are wise, but they do not know the specifics of the journey I am taking. They provide the philosophic grounding for the field of phenomenology, but they will rely on me to identify the direction of travel, to give

details of the terrain, and to explain my purpose. As I seek direction I receive sound advice from Tuan's work, *Space and Place*:

Precision is not required in the practical business of moving about. A person needs only to have a general sense of direction to the goal, and to know what to do next on each segment of the journey. (Tuan, 1977, pp. 72-73)

Tuan's statement suggests that I do not need to locate a detailed map, but simply one that shows the general lay of the land. But, where am I going? What is the purpose for my journey? Where have I already traveled? Answers to these questions begin to take shape as I examine the previous chapters. I recognize that on the next segment of my journey I must continue to seek the meaning of student experiences in the inquiry-based science classroom. But, looking back, I have already travelled to many places over many years with dozens of young companions, the students in my numerous classrooms. The journey through multiple inquiry-based space science experiences has given me insights to develop my own rudimentary map. Experiences coupled with deep reflection have unveiled specific points of interest on this map such as wonder, community, and voice. Traveling companions and wise guides have provided essential counsel to see me through the unknown places to places of understanding and to places of beauty.

As I consider where we have been, and what we have done, a map forms in my mind. Its borders reach to the horizons in each direction. Its vantage point is as from above. As Tuan (1977) points out, "The map is God's view of the world since its sightlines are parallel and extend to infinity" (p. 122). It is a map of my own making – documentation of what we have experienced and places we have seen. Between the sketches of particular landmarks, there is open space. Viewing the

landscape of my journey from this perspective affords me a new appreciation for the empty space. The map is not crowded. It offers a sense of open land – space in which to navigate and places yet to explore.

I listen carefully to another guide, Max van Manen, as he offers clear language that articulates the importance of using hermeneutic phenomenology on a journey of this kind. He also provides a methodology that supplies essential guidelines for both orientation and navigation. Throughout this chapter each guide offers greater clarity to the map features I have identified and helps me to chart a course as I prepare for the next leg of the journey, my formal study of student experiences in space science inquiry.

Hermeneutic Phenomenology

I began to walk in the marked trail, stepping into the firm, deep-worn places where bears had walked for centuries. I'm not sure how to describe the experience, but for some reason the word *holy* comes to mind. An ancient and fearful path through a wild and untamed place. I was following a proven way, layed down by those much stronger and far more prepared for this place than me... It awakened some deep, ancient yearning in me. (Eldredge, 2006, p. x)

I am travelling through wild and untamed places from not knowing to understanding. I am seeking deeper understanding. I know I need guidance. The philosophers have prepared a rich foundation – their collective thoughts have carved for us the deep-worn places. Their writings, their texts, become the marked trail, essential to understanding the essential. Their words guide my steps. As Casey (1993) describes in *Getting Back into Place*:

To be guided is not merely to guide oneself. It is to be led by something or someone else. The something is ultimately the natural world, its particular configuration, the lay of the land. But short of this (and just because the land's lay may not be evident or may be quite

confusing), human beings rely on intermediary presences. One such intermediary is the map; another is the local guide, the someone else who knows the way. (p. 250)

Each philosopher provides insight to understanding regarding the phenomenon being explored. Heidegger, Gadamer, and others serve as intermediary presences to guide me in the realm of hermeneutic phenomenology and to interpret the map I have created. It is my choice how to apply their wisdom and how to interpret their meaning. Used wisely, their guidance can offer freedom as well as understanding.

What is Phenomenology?

Phenomenology seeks to discover the essential – the things that “matter.” To begin to answer the question, “What is phenomenology?”, Moran (2000) writes, “Phenomenology...emphasizes the attempt to get the truth of what matters, to describe *phenomena*, in the broadest sense as whatever appears in the manner in which it appears, that is as it manifests itself to consciousness, to the experiencer” (p.

4). In *Being and Time*, Heidegger (1927/1962) states:

The term ‘phenomenology’ expresses a maxim which can be formulated as ‘To the things themselves!’ It is opposed to all free-floating constructions and accidental findings; it is opposed to taking over any conceptions which only seem to have been demonstrated; it is opposed to the pseudo-questions which parade themselves as ‘problems’, often for generations at a time. (p. 50)

To capture the experience of the “experiencers,” the children in the inquiry-based space science classroom, to describe the experience *as* it is experienced, to articulate and amplify the voices of children rather than stating what they “seem” to be thinking and feeling, I turn to phenomenology. Moran (2000) calls Heidegger’s seminal work in *Being and Time* “a new way of seeing” (p. 228). Praising Heidegger, Gadamer writes that his work

...has penetrated everywhere and works in the depths, often unrecognized, often barely provoking resistance...nothing today is thinkable without it. (Gadamer, 1976, p. 139)

For Heidegger, the ontological question (the question of being) and the phenomenological question are inseparable. He states:

Phenomenology is our way of access to what is to be the theme of ontology, and it is our way of giving it demonstrative precision. *Only as phenomenology, is ontology possible...* 'Behind' the phenomena of phenomenology there is essentially nothing else; on the other hand, what is to become a phenomenon can be hidden. (Heidegger, 1927/1962, p. 60)

To get "to the things themselves," to uncover that which is covered, to expose a particular phenomenon as a way of being, Heidegger calls for a dedication to describing life as it is lived. He looks to phenomenology "as the proper mode of access to the phenomena of concrete human life...a way of thinking about human nature that remained faithful to the historical, lived, practical nature of human experience" (Heidegger, 1927/1962, pp. 227-228).

Children see the world through a lens from which adults, especially teachers and parents, can learn. Their concrete human experience is no less valid or important than that of an adult; it is merely different. Children, as they experience the inquiry-based classroom, are given access to a way of being that offers them freedom to explore possibilities, consider varying viewpoints, and practice that which adult educators sometimes seek to protect our children from – the practice of thinking through a problem or question without clear instructions or direction. Educators can debate the particulars of inquiry techniques; however, to listen to Heidegger's advice for the path ahead of me, I must plan to allow students the space and the time to open a dialogue detailing practical aspects of their concrete human life. What questions

should I ask? In what way do I create a climate of conversation that allows us to capture the practical and the everydayness that is so easily overlooked? What issues are relevant to discuss that will uncover or unmask the hidden meanings? Again Heidegger gives direction:

And just because the phenomena are proximally and for the most part *not* given, there is need for phenomenology. Covered-up-ness is the counter-concept to ‘phenomenon.’ (Heidegger, 1927/1962, p. 60)

To experience the inquiry-based classroom is to experience an encounter with not knowing the possibilities that come from confronting that which is not known. To be allowed an opportunity to seek that which is hidden from view, and yet attainable through inquiry – through asking, thinking, seeking, and reflecting – is the enticement of inquiry. Heidegger says that “Every inquiry is seeking [Suchen]. Every seeking gets guided before-hand by what is sought. Inquiry is a cognizant seeking for an entity both with regard to the fact that it is and with regard to its Being as it is” (Heidegger, 1927/1962, p. 24). In the inquiry-based classroom, we seek. Likewise, in a phenomenological inquiry, we seek. In both cases we seek to uncover. Our inquiry is based upon our desire to know. Our desire to know is the essential aspect of science.

Through Heidegger’s influence, I am reminded to remain faithful, in all inquiries, to a core concept of his work, *Dasein*, “...that entity or aspect of our humanness which is capable of wondering about its own existence and inquiring into its own Being” (van Manen, 2003, p. 176). If it were not for *Dasein*, inquiry-based science would have no meaning, no impact, no use. It is because of our distinctly human ability to inquire that inquiry has its value. This uniquely human quality opens

the possibility for inquiry into inquiry-based instruction, even for children as young as ten. Heidegger says, "...Dasein tends to understand its own Being in terms of that being to which it is essentially, continually, and most closely related – the world" (Heidegger, 1927/1993a, p. 58). For children, "being there" in the world, is nothing more than living, experiencing, sensing. The hard work of phenomenology, in the context of this study, is to bring forth the essence of being in the inquiry-based classroom from the student's point of view.

In the introduction to *Being and Time*, Heidegger (1927/1993a) describes the etymological roots of the term *phenomenology*, a word that can be broken into two components, *phainomenon* and *logos*:

The Greek expression *phainomenon*, from which the term "phenomenon" derives, comes from the verb *phainesthai*, meaning "to show itself." Thus *phainomenon* means what shows itself, the self-showing, the manifest. *Phainesthai* itself is a "middle voice" construction of *phaino*, to bring into daylight, to place in brightness. Thus the meaning of the expression "phenomenon" is established as what shows itself in itself, what is manifest...the totality of what lies in the light of day or can be brought to light. (p. 73)

Elaborating on the meaning of *logos*, he writes:

Logos lets something be seen (*phainesthia*), namely what is being talked about...In speech (*apophansis*), insofar as it is genuine, *what* is said should be derived *from* what is being talked about. In this way spoken communication, in what it says, makes manifest what it is talking about and thus makes it accessible to another. (p. 78)

Heidegger (1927/1962) explains that "...the meaning of phenomenological description as a method lies in interpretation" (p. 61). In other words, the descriptive process, based on the phenomenon itself, is based upon hermeneutics, the "science of interpretation" (Onions, 1966, p. 438). The word hermeneutics "derives from the

Greek god, Hermes, whose task it was to communicate messages from Zeus and other gods to ordinary mortals” (van Manen, 2003, p. 179).

One can see, through Heidegger’s influence, that hermeneutic phenomenological research is an attempt to find essences – the being of human beings – by interpreting lived experience as “it shows itself,” not through inference or conjecture, but through the language of those who have the first-hand experience. The language must then be developed into a carefully crafted written text. Again, Heidegger provides insight:

Even in the concrete work of phenomenology itself there lurks the possibility that what has primordially been ‘within our grasp’ may become so hardened that we can no longer grasp it. And the difficulty of this kind of research lies in making it self-critical in a positive sense... The idea of grasping and explicating phenomena in a way which is ‘original’ and ‘intuitive’... is directly opposed to the naïveté of a haphazard, ‘immediate’, and unreflective ‘beholding’. (p. 61)

Far from haphazard, immediate, or unreflective, my experience as a phenomenological researcher to this point has taught me the need for commitment, patience, and endurance as I write my way to understanding through deep reflection and a focus on detail. If I am to capture the lived meaning of children’s experience in the inquiry-based classroom, I must continue to attend to the task at hand, and remain, as Heidegger reminds us, “self-critical in a positive sense.”

Phenomenology and the Essential Nature of the Question

How do we come to pose our questions? When we pose them, how do we go about answering them? No problem just falls from heaven. Something awakens our interest – that is really what comes first! At the beginning of every effort to understand is a concern about something: confronted by a question one is to answer, one’s knowledge of what one is interpreting is thrown into uncertainty, and this causes one to search for an answer. In order to come up with an

answer, the person then begins asking questions. (Gadamer, 2001, p. 50)

To enter into a phenomenological investigation is to be aware of the question and to always maintain a closeness to the question. There exists a drive or passion that, as Gadamer puts it, “causes one to search for an answer” (2001, p. 50). The origin of the word *question* traces back to the same Latin word as *quest*. According to the *Oxford Dictionary of English Etymology* (1966), the common Latin word, *quaerere*, means “seek, inquire” (Onions, p. 731). To *question*, as Webster (2001) puts it, is an “asking; an inquiry” or “a problem; matter open to discussion or inquiry” (*Webster’s New World Dictionary*, p. 1176). *Quest* is defined as a “seeking; hunt; pursuit” or even, “any journey or undertaking in pursuit of a typically lofty or noble goal” (*Webster’s New World Dictionary*, p. 1176). The term, *inquiry* also has a common etymological origin with *question* and *quest*, the prefix, *in*, meaning *into*, and *quaerere*, meaning *ask* (Onions, 1966, p. 477). An inquiry is an “asking into.” The “search for an answer” becomes a quest to the phenomenological researcher – a journey, an undertaking, a hunt, or even a pursuit. The quest, questioning, or inquiry of a phenomenological study always suggests a commitment to a thorough search. No one on a quest takes the journey lightly or without passion and determination. Here we see the intensity of the meaning of the language of phenomenological inquiry as it reveals the essential nature of questioning within a phenomenological investigation.

Gadamer’s work challenges us to question and to seek answers through conversation, language, and interpretation. “As a teacher, Gadamer was concerned to help students to develop the art of understanding and of making something understandable to others” (Johnson, 2000, p. 14). The art of questioning is at the core

of the art of understanding. Van Manen (2003) says that, “A phenomenological question must not only be made clear, understood, but also ‘lived’ by the researcher” (p. 44). It is through the living of the question, the willingness to make a quest of the question, the desire to go a distance and a depth with the question, that deep and lasting inquiry can produce noble purposes. “Making something understandable to others” (Johnson, 2000, p. 14) requires time, commitment, and reflection.

Through Gadamer we see the importance of inquiry and its ability, ultimately, to lead to understanding. Gadamer (1960/1989), elaborating on the nature of the question, remarks, “It is more difficult to ask questions than to answer them” (p. 362) but “...to someone who engages in dialogue only to prove himself right and not to gain insight, asking questions will indeed seem easier than answering them. There is no risk that he will be unable to answer a question” (p. 363). The important, yet difficult, work of the phenomenological researcher is to ask the difficult questions that lead to insight while releasing the tightly held desire to prove what one has already asserted. This openness is not easily attained. Moran (2000), commenting on Heidegger’s hermeneutical structure of the question, reinforces the critical nature of questioning:

Heidegger’s philosophy is distinguished by his radical approach to philosophical questioning. From very early in his career Heidegger realised that the performative nature of questioning required quite a different structure from the structure of *assertions (Aussagen)*, or statements of fact, which traditionally had been analysed by philosophy. Asserting and questioning are both forms of disclosing. The structure of that disclosing is actually more clearly visible in the case of questioning, therefore Heidegger proposes that we pay attention to the nature of questioning itself. Although we are engaged in asking questions all the time, we rarely reflect on what is involved in questioning. (p. 236)

As a phenomenological researcher, I must reflect on the questions I should ask. I must examine closely what I intend to seek. I must remain conscious of my assertions and maintain an openness to asking the questions to which I may hold no assertions. When I consider following such a line of questioning, I immediately think of the word “wonder.” To wonder is to “have curiosity or doubt about” something (*Webster’s New World Dictionary*, p. 1646). It is an emotion that evokes in us a desire to “want to know” (*Webster’s New World Dictionary*, p. 1646). Wonder can also be defined as “a feeling of surprise, admiration, or awe aroused by something strange, unexpected, incredible” (*Webster’s New World Dictionary*, p. 1646). The language here wonderfully captures the essence of phenomenological questioning. The researcher can predictably experience many emotions such as doubt, surprise, and awe as one is captivated by the questions. Gadamer provides additional insight:

All questioning and desire to know presuppose a knowledge that one does not know; so much so, indeed, that a particular lack of knowledge leads to a particular question. (Gadamer, 1960/1989, pp. 365-366)

To wonder is to ask the question to which one is unsure. We do not wonder about that which we already know. We wonder when we do not know. Children, by virtue of their relative inexperience, lack the kind of knowledge gained through being in the world. This is not a criticism, just an observation of the history of their being. Thus, it makes sense that children are given to asking so many questions. It is natural for them to wonder. It is easily understandable why they pose so many questions and why they pose relatively fewer assertions. It stands to reason why they, given opportunity, feel freedom and pleasure in bouncing around ideas.

School can be a place for answers. Phenomenology reminds us that the world is a place to ask questions. Time spent with 4th graders leads one to the same conclusion. Wonder and curiosity are synonymous with the desire to know, hidden in the original meaning of *science*, from the Latin *scientia* meaning knowledge. The root *scient* is derived from the word *scire* which means “know” (Onions, 1966, p. 797). Science literally means *to know* and at the core, this desire to know suggests a natural curiosity – a wondering about the world. Reiterating Gadamer, he captures the meaning of *science* as he reminds us, “All questioning and desire to know presuppose a knowledge that one does not know” (Gadamer, 1960/1989, pp. 365-366).

It seems as though every journey starts with questions. Just beyond the first turn on our journey into the inquiry-based space science classroom “wonder” appeared directly in front of our path. Students expressed their questions and their curiosities regarding space. Likewise, in phenomenology, we select the path that appeals to our interests and passions and pursue the myriad of questions that form. For me, pursuing my questions means looking deeply to the root of my passions, then heading down the dimly lit path looking for answers. More importantly, it means listening to and throughout the experience. The phenomenological philosophers proceeded in much the same way – pursuing their passions and allowing their questions to guide them. For Heidegger, his great pursuit, the question of being, governed his time and thought as he sought to uncover that which was hidden. Gadamer, in his work discusses language and conversation as the centerpiece of human existence. The essence of all phenomenology is to look for the deeper

meaning, in other words, to respond to the questions that arise – to uncover that which is hidden.

Van Manen (2003) says, “To do phenomenological research is to question something phenomenologically and, also, to be addressed by the question of what something is ‘really’ like” (p. 42). While conducting this kind of research, we must always keep before us the question of what it means to look at something phenomenologically. We must challenge ourselves to ask what we mean by “concrete human life.” We must visit and revisit human experiences to ask the questions that bring to light the obvious that may have escaped our notice. Van Manen adds this:

One might say that a phenomenological questioning teaches the reader to wonder, to question deeply the very thing that is being questioned by the question. (2003, p. 44)

With wonder, the phenomenological researcher wonders. We ask the plethora of questions with passion and with sincerity. Leading by example, van Manen reiterates the essential nature of the question in phenomenological inquiry, asking once again, “Is this not the meaning of research: To question something by going back again and again to the things themselves until that which is put to question begins to reveal its essential nature?” (2003, p. 43).

Also critical to the discussion of questioning, is one’s ability to hear and interpret a response. We must pose questions out of our current understanding, but we should also be cognizant of our preconceptions and how they may skew our understanding and interpretation of a response. The phenomenological researcher cannot be satisfied just to think deeply about the question, but must also challenge the motivation of one’s questioning and consider the motivation of the conversant’s

response. Much of Heidegger's work looks to the question of Being, and through his emphasis on ways in which to interrogate the question of Being, he informs us as to the nature of questioning:

But all inquiry about something is somehow a questioning of something [Anfragen bei...]. So in addition to what is asked about, an inquiry has *that which is interrogated* [ein Befragtes]. (1927/1962, p. 24)

Rooted in the term interrogate, is *rogāre* –ask. And from this same root, we have the word arrogance, meaning “aggressive presumption” (Onions, 1966, p. 51). Webster (2001) defines arrogance as, “overbearing pride or self-importance” (*Webster's New World Dictionary*, p. 79). The Latin term *arrogāre* means to “claim for oneself” (Onions, 1966, p. 51). Here is revealed the subtle distinction between a question as the quest for understanding, and the question borne of arrogant assumption, that seeks only the answer that supports its assertion, the easier question that seeks an answer already presumed. The phenomenological quest is to question for the purpose of revealing understanding, to interrogate so as to unveil understanding free from arrogant presumption. The challenge is daunting. The purpose is noble. The outcome is unpredictable, yet the journey is irresistible.

Phenomenology and the Essential Nature of Community and Voice

Today I'd like you to make a map of all the important things that are in your heart, all the things that really matter to you. You can put: people and places that you care about; moments and memories that have stayed with you; things you love to do, anything that has stayed in your heart because you care a lot about it. (Heard, 1999, pp. 108-109)

What does your map of “all the important things” look like? What would be included on the map of some of the famous philosophers of phenomenology? More fundamental to this study, what about the students in the inquiry-based science

classroom? What would be highlighted on their map of important things? Such a map would undoubtedly reveal one's passions. If taken seriously, such an assignment would uncover what is at one's core beliefs and attitudes. Given the time necessary to probe such depths, this exercise could illuminate one's essences.

If one were to examine the responses of 4th graders to this assignment, what role might community play? Or, even if we were to broaden the view of responses to a much larger group from many different age groups and experiences, would community find a place of significance in the classroom setting? I wonder about these questions because as I examine the inquiry-based classroom, hoping to identify things that matter to children, community as a theme repeatedly presents itself. The concept of community, though, is often framed by children in other language such as "*friends, talking, telling, sharing, groups, teams, others, together, or chat.*" Once again, I turn to phenomenology and the philosophers to seek support and clarity.

Gadamer (2001) points to a crucial part of his life's work, stating that "...conversation itself 'is the essence of what I have been working on over the past thirty years'" (2001, p. 10). Elaborating on conversation, he states:

All living together in community is living together in language, and language exists only in conversation. (2001, p. 56)

Here Gadamer highlights the primacy of conversation and the important interrelationships between community, language, and conversation. Where are the boundaries where one can separate community from conversation? What are the distinctions that can be drawn between conversation and language? How can language have shared meaning outside of community?

To converse is to communicate, to talk with. *Converse* comes from the Latin *conversari*, originally meaning to live with (*Webster's New World Dictionary*, 2001, p. 318). To live with or commune together indicates community. This kind of living-with or being-with hints of a feeling of *home*. Sinclair (1994) elaborates: "Home is the point or place in which we feel secure enough to begin taking risks..." (p. 9). In Heidegger's (1947/1993b) words, "Language is the house of Being. In its home man [sic] dwells" (p. 217). O'Donohue says, "When you are understood, you are at home. Understanding nourishes belonging" (1997, p. 14). At home, we are within a community, we are with others, we are with others who are willing to take risks, share ideas, and engage in meaningful conversation. In community, are we beginning to see a picture of the inquiry-based classroom? How does the inquiry-based classroom give us an experience of home? How is community like inquiry?

Community is home for conversation.
Conversation is home for language.
Language is home for community.

Home is a place for community.
Home is a space for conversation.
Home is where language dwells.
(Horne, 2009, reflective writing)

Heidegger reinforces this interconnectedness and illuminates a core element of community. He states that "Being-with develops in listening to one another" (Heidegger, 1927/1962, p. 206). In this simple quote, he highlights the important bridges between community, language, and conversation – namely listening. There can be no community without it. Conversation is shut down in its absence. Language spoken but not heard is lost. O'Donohue (1997) writes, "There is a very important

distinction to be made between listening and hearing. Sometimes we listen to things, but we never hear them” (p. 71). Heidegger elaborates:

We can make clear the connection of discourse with understanding and intelligibility by considering an existential possibility which belongs to talking itself – hearing. If we have not heard ‘aright’, it is not by accident that we say we have not ‘understood’. Hearing is constitutive for discourse. And just as linguistic utterance is based on discourse, so is acoustic perception on hearing. Listening to . . . is Dasein’s existential way of Being-open as Being-with for Others. Indeed, hearing constitutes the primary and authentic way in which Dasein is open for its ownmost potentiality-for-Being – as in hearing the voice of the friend whom every Dasein carries with it. (Heidegger, 1927/1962, p. 206)

Hearing, discourse, listening, Being-open, Being-with, Dasein (being there), voice – all such language stirs imagery, emotion, metaphor. When I consider my classroom I cannot escape a picture of students in a circle. They are engaged, alive, present, and focused. I am silent, listening, smiling, and attentive. What I see is invisible, yet it is tangible. It is openness. But what is it I am able to observe with my senses? What does openness look like? Heidegger (1971) states, “Man [sic] first speaks when, and only when, he responds to language by listening to its appeal” (p. 214). Listening opens us to growth as learners and as community. Gadamer says, “Anyone who listens is fundamentally open. Without such openness to one another there is no genuine human bond” (1960/1989, p. 361).

In the inquiry-based classroom, the human bond exists between students, but also between the teacher and the students. Van Manen (2002) states:

The physical presence of the body in the classroom involves a sharing of that same space with other students and the instructor. This “sharing” implies a certain attentiveness, and openness to participation, and even a certain vulnerability. (p. 228)

A sense of vulnerability can be a part of the experience of sharing within a community. But, van Manen calls it “a certain vulnerability.” It is not a debilitating vulnerability or a silencing vulnerability. The vulnerability expressed by van Manen involves risk, yet is followed by trust. The experience creates an opportunity for a bond to form. Heidegger (1947/1993b) says, “To embrace a ‘thing’ or a ‘person’ in its essence means to love it, to favor it” (p. 220). Here he beautifully describes the impact of the act of embracing as seen when individuals within a community connect, or when the bonding of a group brings an increased acceptance or love. In the inquiry-based classroom, the teacher, as part of the community, must learn to take on a subtly different role. Van Manen (2002) explains:

In a conversation it may even happen that the teacher somehow forgets him- or herself as a teacher, in charge of the class discussion. Now the teacher may become more like a participant, sharing personal meanings... Thus, in letting a conversation happen the teacher may have the opportunity to remain open and to listen and come to understand the inner life of students. And, in turn, the students are enabled to open and share their personal experiences. (p. 89)

The kind of community that can exist in an elementary school classroom, open to vulnerability, and listening, willing to share personal experiences, and accepting of variant voices, describes the same sort of trusting teacher-student relationship needed to experience deep inquiry in the inquiry-based classroom. It is, in fact, the same depth of relationship needed for a phenomenological researcher to attain open conversation with conversants in a phenomenological study. Through reflection on the teacher-student relationship, I am reminded of a quote from a lecture by Dr. James Comer. He states, “No significant learning occurs without a significant relationship” (as cited in Payne, 1996, p. 18). I wonder about the experiences that led

Dr. Comer to come to such a conclusion. The quote points to the significance of community in the learning process. What is it like for a student to experience significance in the school setting?

If phenomenology is what it claims to be – a more concrete view of phenomena, a less theorized view of experience, a reflection on *being-there*, then the work of the phenomenological researcher should provide a glimpse at the maps of “important things” experienced by the participants, in the case of this work, the students’ experiences in the space science classroom. Phenomenology’s claim is to provide a window into the essential and fundamental. Essential to the inquiry-based classroom experience is an experience with community, and fundamental to community is listening. But what place does *space*, the overarching focus of this study, play in the child’s lived experience?

Phenomenology and the Essential Nature of Space

Deductive reasoning was all well and good, but I loved to just let my mind go and soar the endless reaches of space, where lines crossed to create points with no dimensions at all and parallel lines intersected in infinity. I started to think a lot about infinity, and what it was like there, and how all the postulates and theorems and principles were true across all the universe. I lay in my bed at night... and looked up into the darkness and allowed my mind to go wherever it wanted to go. Sometimes when I did that it felt like I was actually flying, soaring into the night sky...(Hickam, 1998, p. 169)

Everybody needs space. As Tuan (1977) points out, “Space is, of course, more than a complex and shifting viewpoint or feeling. It is a condition of biological survival. But the question of how much space a man needs to live comfortably has no easy answer” (p. 57). How much space a child needs in the inquiry-based classroom is, likewise, difficult to assess. Complicating the matter further, the concept of space

has provided endless struggles to the great minds of science and philosophy. Abram (1996) provides a brief history here:

In 1905, Albert Einstein challenged the Newtonian view of absolute time and absolute space with his “special theory of relativity.” Einstein’s equations in this, and later in the “general theory of relativity,” did not speak of time and space; they assumed instead, the existence of a unitary continuum that Einstein termed “space-time.” (p. 204)

Einstein’s theory that space curves around massive objects was first confirmed by calculations gathered during a solar eclipse on May 29, 1919. Einstein showed that “Time itself varies between reference frames whose relative speed approaches the speed of light... When the relative speed reached the speed of light, time would seem to stand still” (Goldberg, 1996, p. 46). Space is inexorably linked with time. All motion is relative. A person moving at a very high rate of speed will experience, though not detect, a slowing of time. Even so, the day-to-day experience of space and time are subject to our perceptions and do not seem at first greatly impacted by Einstein’s discoveries.

Interestingly, several key philosophers of phenomenology also made in-depth studies of the undeniable link of space and time. Abram (1996) summarizes:

...Husserl, Heidegger, and Merleau-Ponty – came independently, in the course of their separate investigations, to suspect that the conventional distinction between space and time was untenable for the standpoint of direct, preconceptual experience. Heidegger and Merleau-Ponty were both striving, toward the end of their lives, to articulate a more immediate modality of awareness, a more primordial dimension whose characteristics are neither strictly spatial nor strictly temporal, but are rather – somehow – both at once. (pp. 205-206)

As children in the space science classroom experience space and time, it is important to remain focused on how the encounter as a whole is perceived, not whether the

child can articulate a notable distinction between lived space and lived time, or, for that matter, any of the existentials. In *Phenomenology of Perception*, Merleau-Ponty remarks that phenomenology is:

...a philosophy for which the world is always 'already there' before reflection begins – as an inalienable presence; and all its effort are concentrated upon re-achieving a direct and primitive contact with the world, and endowing that contact with a philosophical status. It is the search for a philosophy which shall be a 'rigorous science', but it also offers an account of space, time, and the world as we 'live' them. (1945/2002, p. vii)

Reflections of the lived experience in the space science classroom, must, without question, account for the phenomena of space and time and articulate the child's perspective. The question at the heart of the study, and purposefully stated in the title, *Giving Children Space*, not only requires that I delve into the lived meaning of space and time-space, but I must also consider how the student experiences the giving or receiving of space. Some amount of space and time is typically given to the subject of science at the elementary school level; however, the nature of the inquiry-based classroom insists that the teacher deliberately looks for and provides enough space to make the experience increasingly meaningful. How does the amount of time and space provided affect the child's experience? What is it like to be *given* space? What is it like for a child when space is taken away or not perceived as having been adequately provided?

In *Last Child in the Woods: Saving our Children from Nature Deficit*

Disorder, Richard Louv (2005) indicates a big picture effect of space on children:

Growing up, many of us were blessed with natural space and the imagination that filled it...America's genius has been nurtured by nature – by space, both physical and mental. (p. 96)

Were those to whom he is referring given space, or was it just “there?” If the idea of “America’s genius” has its origins in physical and mental space, what do those experiences look like? Louv goes on to suggest that such “space” in America is dwindling as influences from our modern culture increasingly draw the young indoors and away from an encounter with nature. For a teacher to “give children space,” an effort must be made to invite children into open spaces, allowing them opportunities the closed-in places of the classroom might not provide. Increasingly, the use of technology, such as the Internet, is touted as a powerful learning tool in the classroom. How do children experience many of the newest technologies? What is it like for them to use the Internet to see the moon as it is supposed to appear in the sky? How do technologies factor into the child’s experience of space? Instant access to information is hailed as a wonder of the modern world. How does having such knowledge at one’s fingertips in the elementary classroom translate into an experience of expanded space? How does more information, received faster, equate to space? Is a world of high speed and instant access a place of increased space?

A story in the *The Spell of the Sensuous* offers another perspective:

...a strong hurricane ripped across...For several days afterward, much of the populace was without electricity...at night the sky was studded with stars! Many children, their eyes no longer blocked by the glare of houselights and street lamps, saw the Milky Way for the first time, and were astonished. For those few days and nights our town became a community aware of its place in an encompassing cosmos...the breakdown of our technologies had forced a return to our senses, and hence to the natural landscape in which those senses are so profoundly embedded. (Abram, 1996, pp. 62-63)

In this instance, it would appear that the lack of technology opened an opportunity for children to experience a different kind of space. From the quote above, Abram states,

“The breakdown of our technologies had forced a return to our senses...” (p. 63). In an inquiry-based space science classroom experience, space to encounter earth, sun, and sky more directly through the senses seems essential. But what about similar experiences lived through the use of technology? Conversations with children as they experience direct observation of phenomena such as moon phases or the movement of the sun, as well as technology-based experiences of the same phenomena, will reveal insights into the students’ lived experiences in this technology-rich world.

In *The Poetics of Space*, Gaston Bachelard (1994) offers yet another perspective:

There is nothing like silence to suggest a sense of unlimited space. Sounds lend color to space and confer a sort of sound body upon it. But absence of sound leaves it quite pure and, in the silence, we are seized with the sensation of something vast and deep and boundless. (p. 43)

Silence can be experienced with or without vast amounts of space, indoors or outdoors, with a large group or in extreme solitude. Here, Bachelard makes an intriguing claim. How will children experience silence in the space science classroom? Like being out in the open wilderness, or lost in the abundance of information available through our computers, can an experience of silence offer a sensation of increased space and time? In a finite world, what is it like to be “seized with the sensation of something vast and deep and boundless?” In order to know, I must continue to ask, continue to probe, and continue to consider varying perspectives.

Experiencing Space, Opening Horizons

For a space to be a space, it must be open as well as bounded – open to many paths down which discovery may take us, to the surprises that

always come with real learning. If boundaries remind us that our journey has a destination, openness reminds us that there are many ways to reach that end. (Palmer, 1998, pp. 74-75)

I have explored a few ways in which space can be encountered. What other kinds of spaces are experienced in the inquiry-based classroom? How does the experience allow one to follow “many paths?” When in the experience does one discover “surprises that always come with real learning?” Phenomenologically, in what manner does one describe the experience of space? Palmer suggests that certain qualities must exist for a space, “to be a space.” He states that the space must be both open and bounded. Wide open space, like a dark night sky, can feel threatening, lacking anything of familiarity, ominous. Counter to intuition, children find it more comfortable to play in fenced areas than wide-open spaces with no obvious boundaries or fences. Without a known stopping point, the open space can feel dangerous, leaving one open to a sensation of a looming threat. Conversely though, tight, cramped spaces can be oppressive and limiting. What does it mean to have a space that is both open and bounded?

Palmer uses the term *bound* in the quote above, as in “to limit” (Onions, 1966, p. 110). An associated term, *horizon*, comes from a French term *hóros* meaning “boundary, limit” (Onions, 1966, p. 448). *Webster’s New World Dictionary* (2001), defines the term *horizon* as follows: “Bounding circle, boundary, limit. Akin to Latin *urvus*, city boundary, originally furrow around city” (p. 688). The Latin form, *urvus*, suggests a border that offers protection from outside forces, like a walled city with a mote. Horizon is also defined as “the limit or extent of one’s outlook, experience, interest, knowledge” (*Webster’s New World Dictionary*, 2001, p. 688). Palmer’s

description of space refers to bounds or limits, but within those boundaries or distant horizon lines, the space is also welcoming, spacious, freeing. The view is both vast and yet contained. Within this contained space there is freedom to move without fear of harm. The space is defined, yet adequate to provide numerous options for travel. But thinking of horizons or boundaries in this way assumes a certain fixed vantage point and a defined border.

Depending on a person's point of view, the horizon can take on various shapes and sizes that can expand or contract. From certain vantage points, one can turn 360 degrees and experience a far off horizon in every direction. Sometimes horizon views can be limited by obstacles such as buildings, rocks, or trees. Out on the ocean, the horizon is flat and low, marked by the separation of sea and sky. From a high mountaintop, the horizon can seem far off and unreachable. Higher still, far above the earth's surface, horizon takes on a completely different look. An astronaut orbiting the planet at about 200 miles above the earth experiences horizon much differently. Here the horizon line of earth shrinks. The experience aboard the space shuttle is described as a sensation of standing still with the earth turning slowly beneath, though in reality, shuttle astronauts are circling the earth, traveling 5 miles every second (Mullane, 1991). In the astronaut's experience 200 miles up, the horizon does not seem to expand; however, the tremendous speed creates a constantly changing view of earth features. Horizon from space cannot be viewed statically as from a high peak, and therefore, is experienced differently with the added sensation of motion. And, as Abram (1996) points out, "The other side of that rock, for instance, is held from my

gaze, but it is not refused, for I can disclose it by walking over there, just as I can disclose what lies beyond the horizon by making a longer journey” (p. 213).

Whether moving, or still, in space, or at sea level, the human experience of horizon still assumes an earth referenced view. Looking down from space, earth features can be identified, but political boundaries are invisible. Looking out over the earth, the horizon forms an arc. Only in the uninhibited view of a space-walk can an astronaut take in the circular nature of the horizon line. Essentially the earth, much like the ocean viewed from sea, appears as a flat circular disk. The horizon line as seen from space is the edge between earth and the blackness of space. Looking away from our planet, though, the horizon disappears. The darkness of space, void of the context of earth, opens to a limitless void. Without any horizon, all sense of space is lost. The experience can even be disorienting. Even from earth, we can look to the heavens, focus our gaze on the abyss of space, and lose all sense of horizon. Though intuition might suggest that such a view would cause discomfort or fear, for many it is the black emptiness of space that calls to them.

In the video, *The Ten Thousand Night Dream*, Mike Mullane, a former space shuttle astronaut, tells of his final shuttle journey, STS-36, aboard the space shuttle Atlantis. On the morning of February 28, 1990, the crew is shuttled to the launch pad. Mullane relates the details:

Then our driver makes a turn and... Atlantis looms into view. She is a solitary diamond on sable black. A white dazzling monument to man's and woman's primordial yearning to see beyond the horizons.
(Mullane, 1991)

Here Mullane refers to *horizon* as a boundary that humans long to traverse, a new vantage point to be experienced, a place from which we can look away from earth,

uninhibited by her form. He describes a human passion to see beyond that which is currently able to be seen, a desire to move out beyond the confines of our own horizons.

Gadamer comments on horizons:

The horizon is...something into which we move and that moves with us. Horizons change for a person who is moving. (1960/1989, p. 304)

But, is it possible to move beyond one's horizon? In human experience, different horizons can be viewed as one changes location, but being-where-we-are, we cannot see beyond our own horizon, we can only move to varying locations to experience new horizons. NASA's current mission to Pluto and beyond, interestingly named *New Horizons* (<http://pluto.jhuapl.edu/>), launched on January 19, 2006, will reach Pluto in July, 2015. In terms of human experience, the introduction of space travel has allowed us to see horizons that cannot be defined by the limits of earth. As Gadamer (1960/1989) describes it, "A horizon is not a rigid boundary but something that moves with one and invites one to advance further" (p. 245). His description seems to capture the vision of those longing to explore further and deeper into space.

But, what is the meaning of the term *horizon* as Gadamer uses it? Johnson (2000), commenting on Gadamer's phenomenological notion of horizons, states:

He maintains that the human world, the world of our lived experience, is linguistic... Language forms the horizon of human experience. It provides the parameters in which all experience takes place, but it is also a space that can expand and contract and in which humans are situated and can move. (p. 47)

Gadamer's metaphorical use of the word horizon, juxtaposed with an analysis of the term *horizon*, bring insight to the notion of space in the inquiry-based classroom.

Without language, the scope of one's horizon would be diminished to nothing, like being closed off in a box. Gadamer (1960/1989) further elaborates:

The horizon is the range of vision that includes everything that can be seen from a particular vantage point. Applying this to the thinking mind, we speak of narrowness of horizon, of the possible expansion of horizon, of the opening of new horizons, and so forth. (p. 302)

The implications for space in the inquiry-based classroom are overwhelming. To give students voice, to allow time for the horizons of many individuals to be explored, to allow questions to form and ideas to be considered, is to give space. To shut down conversation, to limit discussion, to ration voice is to constrict the space.

Tuan (1977) offers an interesting insight on space, stating:

People crowd us but they can also enlarge our world. Heart and mind expand in the presence of those we admire and love... When people work together for a common cause, one man does not deprive the other of space; rather he increases it for his colleague by giving him support. (p. 64)

The amount of physical space someone "needs" varies widely, depending upon individual circumstance, previous experiences, dispositions, and temperaments. Even in a physically limiting space, though, those working toward a "common cause," those working as a community, can find advantage in a limited space. Gadamer describes the concept of horizon as a kind of knowing. He explains:

A person who has no horizon does not see far enough and hence over-values what is nearest to him. On the other hand, "to have a horizon" means not being limited to what is nearby but being able to see beyond it. A person who has a horizon knows the relative significance of everything within this horizon, whether it is near, or far, great or small. (1960/1989, p. 302)

Having "a horizon" is to have knowledge. Being able to see beyond the horizon suggests an advanced level of insight and imagination. The individual with

such skills is someone with great vision and superior understanding. These traits align with the tenants of the inquiry-based science class. Just as a space explorer has vision to see beyond the bounds of earth's horizon and even beyond far-off horizons, so the inquiry-minded student and teacher develop ever expanding horizons of understanding through questioning and conversation. Gadamer (2001) further explains:

So one of the most essential experiences a human being can have is that another person comes to know him or her better. This means, however, that we must take the encounter with the other person seriously, because there is always something about which we are not correct and are not justified in maintaining. Through an encounter with the other we are lifted above the narrow confines of our own knowledge. A new horizon is disclosed that opens onto what was unknown to us. In every genuine conversation, this happens. (p. 49)

According to Gadamer (2001), at the core of opening new horizons, we find ourselves in conversation. To reiterate, he says that "...the most essential experiences a human being can have is that another person comes to know him or her better" (p. 49).

Knowing another opens new horizons and is a result of community. Knowing takes place through conversations, allows for voice, and sparks an attitude of wonder, thus creating a greater sense of space.

The term *space* indicates the content focus of this study as well as a description of the lived experiences of children in the inquiry-based classroom, thus the title of this work, *Giving Children Space*. The term *horizon*, likewise, holds meaning for the student of astronomy, but also has significance for the inquiry-based classroom, as well as the phenomenological researcher. Horizons in the phenomenological sense suggest degrees of *understanding*. How do we deepen our level of understanding in the inquiry-based classroom? How do we expand our

understanding as phenomenological researchers? What lived meaning is unmasked as understanding is opened to critique and discussion?

Not only does Gadamer focus on the idea of horizons in a phenomenological sense, he also expounds on the concept of the fusion of horizons. Taylor (2002) sheds light here on Gadamer's idea of fusion:

If understanding the other is to be construed as a fusion of horizons and not as possessing a science of the object, then the slogan might be: no understanding the other without a changed understanding of self.
(p. 141)

The fusion of horizons, the coming together of ideas from different perspectives, broadens each person's horizons, creates new horizons, and in so doing, produces a fundamental change in each affected individual.

Imagine a group of students standing together on a mountaintop vista, facing out, arm-in-arm, in a circle. Collectively they experience the entire horizon at once. Picture the living exchange of conversation, each participant vividly describing that which they experience visually from their vantage point. Through listening to and sharing with one another in descriptive language, each individual in the group begins to see the complete panorama in his/her mind's eye. Members in the group begin to fuse the horizon into one contiguous picture. As conversation continues, questions are being exchanged, responses are given, and details are added. They each experience a fuller picture of the reality that surrounds them. The experience offers them a greater sense of the space that engulfs them. In a sense, their ability to engage in conversation opens the space to them, making it larger, more expansive, and greater in scope.

Gadamer (2001) further elaborates:

Whoever speaks a “language” that nobody else understands is not really speaking. Language is not something assigned by individual human subjects. Language is a *we*, in that we are assigned our place in relation to each other, and in which the individual has no fixed borders. This means, however, that we all must overstep our own personal borders/limits of understanding in order to understand. This is what happens in the living exchange of conversation. (p. 56)

Likewise, this is what happens in the living exchange within the inquiry-based science class. The great task ahead is to articulate the children’s voices as they overstep their own personal borders and broaden their understanding in the conversation rich, communal space of the 4th grade space science classroom.

So that the experience in the inquiry-based science classroom can be carefully documented and articulated, I turn now to a more thorough explanation of the methodology to be used in the formal study. Van Manen’s (2003) methodological guidelines for conducting phenomenological inquiry are articulated in relation to my study, as I pursue the question: **What is the lived experience of 4th grade students engaged in the process of space science inquiry?**

Hermeneutic Phenomenology as a Methodology

The starting point of phenomenological research is largely a matter of identifying what it is that deeply interests you or me and of identifying this interest as a true phenomenon, i.e. as some experience that human beings live through... to orient oneself to a phenomenon always implies a particular interest, station, or vantage point in life...It is because I am interested in children and in the question of how children grow up and learn that I orient myself pedagogically to children in a phenomenological hermeneutic mode. (van Manen, 2003, p. 40)

Space science has been the consistent content focus of my doctoral studies for the past decade. My interest and passion for the cosmos has been with me as long as I can recall. Of equal importance has been my curiosity regarding space science pedagogy. Questions in my mind have been ongoing and relentless. I can still

envision myself many years ago standing before a classroom of 4th graders, asking the children to think and to wonder about the earth, sun, and moon as we explored various concepts with physical models. I close my eyes and I am there. It is Mrs. A's corner classroom. I haven't been there in many years but I can picture it like a photograph: where I stood, the position of the children's desks, the way the light enters through the side windows. I am the guest teacher. Eager faces greet me. As the lesson unfolds I am nagged by my own endless questions. How are the questions I am posing important for the children to consider? Of what use is such information? In what way does any of this material matter to these children? What is the purpose of this activity? As I quiz myself, I am skeptical of my next steps, yet I press through the lesson as other questions emerge. I wonder: Why do they listen so intently? What is it about the study of space that seems to have so fully captivated their interest and attention? What is going on in their heads? What are they wondering? What must it be like to be in their seats right now? Van Manen (2003) states:

To truly question something is to interrogate something from the heart of our existence, from the center of our being. Even minor phenomenological research projects require that we not simply raise a question and possibly soon drop it again, but rather we "live" this question, that we "become" this question. (p. 43)

Over the course of my studies, many answers have emerged regarding the rationale and purpose of using an inquiry approach. I now better understand its value and potential. Pedagogically, inquiry-based science makes sense. But not all of my questions have been answered. I have changed. My approach has changed. My thinking has changed. But, still, I cannot say I know what it is like to be the child in the back row of Mrs. A's classroom. I still wonder: What is the experience like for the

child? What will the child remember of this experience? Why do children recall certain experiences and not others?

As I was first introduced to phenomenology at the University of Maryland, taught by Dr. Francine Hultgren, it became apparent that the very questions that have troubled and intrigued me over many years can be investigated through the methodology described by Max van Manen. In the text, *Researching Lived Experience*, he states:

Hermeneutic phenomenology tries to be attentive to both terms of its methodology: it is a *descriptive* (phenomenological) methodology because it wants to be attentive to how things appear, it wants to let things speak for themselves; it is *interpretive* (hermeneutic) methodology because it claims that there are no such things as uninterrupted phenomena. The implied contradiction may be resolved if one acknowledges that the (phenomenological) “facts” of lived experience are always already meaningfully (hermeneutically) experienced. Moreover, even the “facts” of lived experience need to be captured in language (the human science text) and this is inevitably an interpretive process. (2003, pp. 180-181)

To engage in a research methodology that is both descriptive and interpretive requires the researcher to live in tension. The purpose of my research is to give voice to children as they express the meaning of the lived experience of the inquiry-based space science classroom, but as van Manen (2003) reminds us, “A person cannot reflect on lived experience while living through the experience” (p. 10). Therefore, I must capture the essence of the experience as the children reflect upon it, and then I must yield to the language of the text they create as we reflect on the shared experience.

Van Manen's Six Research Activities

As mentioned in Chapter One, van Manen (2003) provides guidance through a description of the dynamic interplay among six research activities, which serve as a useful methodological structure for phenomenological research. The research activities include: “(1) turning to a phenomenon which seriously interests us and commits us to the world; (2) investigating experience as we live it rather than as we conceptualize it; (3) reflecting on the essential themes which characterize the phenomenon; (4) describing the phenomenon through the art of writing and rewriting; (5) maintaining a strong and oriented pedagogical relation to the phenomenon; (6) balancing the research context by considering parts and whole” (pp. 30-31).

The six research activities serve to provide structure and focus for this study. The activities are not meant to be used as a comprehensive list, or series of directions, but rather, as a set of guidelines from which to draw and gain insight into the lived phenomenon at the heart of the study. Nor are the activities designed to be used in linear fashion, but instead, should be thought of as overlapping and intertwined. Van Manen reminds us that, “Discussions of method and methodology are meant not to prescribe a mechanistic set of procedures, but to animate inventiveness and stimulate insight” (p. 30).

Thus far, each of the research activities have been instrumental in stimulating my creativity and inventiveness as I have sought to lay the foundation for my formal study by maintaining a closeness to the topic over many years and through multiple changes in placements and positions within a public school system. Throughout, I have continued to fix my gaze upon the students in the elementary science

classrooms, seeking a deeper understanding of their lived experience of space science inquiry. In preparation for a formal study of the lived experience of 4th graders in an inquiry-based space science classroom, I must maintain my focus, cling to tenacity, and look more carefully at each of the research activities provided by van Manen.

Only with such a commitment could I have prepared for the task.

1) Turning to a phenomenon which seriously interests us and commits us to the world

We may possess a certain amount of information in literature, math, or science, but only the knowledge we embody has truly become a part of our being. A real English teacher tends not only to love reading, writing, and carrying poetry under one arm during a coffee break; a real English teacher cannot help but poetize the world – that is, think deeply about human experience through the incantative power of words. (van Manen, 1986, p. 46)

In Chapter One, I begin to articulate my passion to know more about the lived meaning of experiences in the space science classroom. Paraphrasing van Manen's words, I have turned towards, and stayed fixed upon a phenomenon which seriously interests me and which calls me. I am fascinated by and committed to the world of children as they learn and grow and develop their own love of learning. My lifelong fascination with space, my ever developing interest in teaching, and my career path which has kept me in the halls of elementary schools for over 25 years, have led me to where I am today. I am ready to take the next step toward understanding. I am ready to lean in close and listen for the next insight. I am ready to hear and teach and learn and grow. O'Donohue (1997) beautifully describes this emotion:

When you give in to creative passion, it will bring you to the ultimate thresholds of transfiguration and renewal. This growth causes pain, but it is sacred pain. It would be much more tragic to have cautiously avoided these depths and remained marooned on the shiny surfaces of the banal. (p. 22)

Deep and abiding interest is the fuel that presses me along and strengthens my commitment to go deep rather than accept the banal.

As I shift focus from one of van Manen's research activities to the next, remember that a phenomenological researcher does not consider a methodology in terms of checklists or tasks to be accomplished. It is best to think of each activity as cumulative in nature. Regardless of the research activity, the students' experiences remain utmost on my mind.

2) Investigating experience as we live it rather than as we conceptualize it

...circumstances never repeat themselves. Not exactly. I couldn't get to those kind of songs for him or anyone else. To do it, you've got to have power and dominion over the spirits. I had done it once, and once was enough. Someone would come along eventually who would have it again – someone who could see into things, the truth of things – not metaphorically, either – but really see, like seeing into metal and making it melt, see it for what it was and reveal it for what it was with hard words and vicious insight. (Dylan, 2004, p. 219)

In this quote from Bob Dylan's autobiography, as he reflects on his experience as a songwriter, he also aptly describes the experience of a phenomenological researcher. I hear my calling as a researcher when he writes, "...someone who could see into things, the truth of things – not metaphorically either – but really see..." (Dylan, 2004, p. 219). He perfectly captures the task at hand. I must capture "the truth of things" as experienced by children and then find the "hard words" and "vicious insights" these experiences elicit. It is easy to drift from the lived to the theorized. That is why the phenomenological researcher must stay committed to investigating lived experience. Van Manen elaborates:

Husserl's phrase "back to the things themselves" means that the phenomenological attitude is mindful of the ease with which we tend to rely on a reconstructed logic in our professional endeavors. We read

theories into everything...In our efforts to make sense of our lived experiences with theories and hypothesizing frameworks we are forgetting that it is living human beings who bring schemata and frameworks into being and not the reverse. (van Manen, 2003, p. 45)

I must learn to focus on that which is lived. I must learn to focus on that which is experienced. I must learn to not become satisfied with conceptualizations. I want to know what it is like for children to experience events, activities, and actions in the inquiry-based space science classroom. I want to know what it is like for them as they discover their experience of being. I want to give them opportunities to articulate what they imagine they are becoming.

As I proceed to the next research activity, I do so with a profound commitment to investigate the lived experience of those for whom I have an abiding concern in a context for which I have a deep interest. Over and over, I must remind myself to look “back to the things themselves.” I must hold on to a desire to capture the 4th grade classroom as it is lived.

3) Reflecting on the essential themes which characterize the phenomenon

The understanding of some phenomenon, some lived experience, is not fulfilled in a reflective grasp of the facticity of this or that particular experience. Rather, a true reflection on lived experience is a thoughtful, reflective grasping of what it is that renders this or that particular experience its special significance. (van Manen, 2003, p. 32)

Classroom experiences do not always “feel” significant. Days pass into weeks, weeks into months, and throughout these long stretches of time, most of the experience can seem routine. But, through careful reflection, and thoughtful analysis, something of the significance of the time begins to emerge. In my analysis of the 4th grade space science classroom thus far, moments of significance have revealed themes, including the wonder prevalent in children, their desire for community, their

need to express voice, and their longing for space. As the formal study unfolds, I continue to seek deeper understanding of these emerging themes and carefully listen for the emergence of other significant themes that announce themselves.

It is important to clarify the term “significant” as used in this context. An event or remark in the classroom may be considered significant in terms of its impact on the class, but not be significant in the phenomenological sense. For example, a student might say to the cheers and approval of the class, “Remember the time Bernard got sick in the middle of the lesson on rockets?” But this “significant” event would certainly not qualify as essential to the inquiry-based experience. Even seemingly significant events that repeat themselves in the inquiry-based classroom do not necessarily indicate a potentially significant theme. Van Manen (2003) distinguishes between incidental and essential themes, asking, “Is this phenomenon still the same if we imaginatively change or delete this theme from the phenomenon? Does the phenomenon without this theme lose its fundamental meaning?” (p. 107). Given the criteria, the initial themes I have identified present themselves as essential. For example, one could not imagine an inquiry-based experience void of wonder.

Essential themes emerge over time and through careful scrutiny. Van Manen states, “In determining the universal or essential quality of a theme our concern is to discover aspects or qualities that make a phenomenon what it is and without which the phenomenon could not be what it is” (p. 107). The lived experience of the inquiry-based space science classroom is made up of countless encounters, stories, and events. Determining which of these events characterize the experience essentially and which only incidentally characterize the experience is difficult and

time consuming. Likewise, determining which stories to tell and which to leave untold is equally difficult. Van Manen reminds us that "... every phenomenological description is in a sense only an example, an icon that points at the 'thing' which we attempt to describe" (p. 122). The challenge, then, is to remain aware of the emerging themes and to select stories carefully that characterize that theme.

Sometimes evidence will present itself that helps to support a decision to incorporate a particular phenomenological description. Such supporting evidence just came in the mail. Today I received a handwritten note from the father of Paula, a former student. He writes,

Our family continues to be addicted to Altoids and you will be proud to know the interest you sparked in a 4th grader has become her life goal: to make a difference in the world through science. As a 10th grader she still talks about the experiences you facilitated as if they were yesterday – well done!

It was Paula who taught us something about community when she wrote a paragraph on the MAD strategy invented by several classmates to improve the Samoan Circle activity. At the time, Paula was desperate to share her ideas with the class (express voice), desperate for a community that would work together, desperate for space. Her experiences in science class years ago have stayed with her and influenced her plans for the future. The letter from Paula's father allowed a window into the impact of an experience in the inquiry-based classroom. At the end of the paragraph she wrote as a 4th grader: "I have another story to tell but I'll save that till next time. Thank you, Mr. Horne!!"

As a researcher of phenomenology, it is critical that I capture the essence of such classroom stories and draw thematic essences from them, so that through these

stories, we can all acquire a deeper sense of the meaning of classroom experiences that we may have otherwise taken for granted. Paula's story is just one example of thousands of experiences that have taken place during my time in the inquiry-based classroom. The hard work of the researcher is to maintain a closeness to the experience so that stories from the classroom can be captured and essential themes can be uncovered.

Van Manen writes, "Phenomenological research consists of bringing into nearness that which tends to be obscure, that which tends to evade the intelligibility of our natural attitude of everyday life" (2003, p. 32). Again, as I consider the cumulative nature of multiple research activities, I hold fast to that which seriously interests me while taking notice of life as lived in the everyday experiences of the inquiry-based classroom while carefully reflecting on emerging themes.

4) Describing the phenomenon through the art of writing and rewriting

While lived experience is the starting point and the end point of phenomenological research, transforming that lived experience into a textual expression of its essence is a laborious task. And yet for some that transformation of lived experience descriptions into phenomenological descriptions is the breath and heart of writing... (Hultgren, 1995, p. 382)

I fill notebooks with words, feelings, emotions, and prayers. Most days I make time to journal. Days that I do not journal feel incomplete. I frequently type reflections when I sit down at the computer. I jot notes, make lists, and generally write down everything I can. It is almost as if I think that if I do not write it down, it is not real – like it never happened. Somehow I equate existence with the written

word. Perhaps an obsession with writing is some prerequisite for phenomenological work.

Regardless of my writing habits, the phenomenological researcher must become comfortable with the task of writing and rewriting. Comfortable does not, however, equate to easy. The work of writing and rewriting is painstaking and challenging. In *Writing in the Dark*, van Manen (2002) describes the process of writing as experienced by contributors to the text:

They read like simple texts. But the ease of simplicity is deceptive. Without exception the authors of these texts have commented how hard the writing has been. In spite of our many seminars practising phenomenological inquiry, the writing remains painful, difficult, disorienting. . . .it was like trying to find their way through darkness; a strange, solitary experience, like writing in the dark. (p. 2)

If the writing is so difficult, then why do it? For my part, the pull of the writing comes from a desire to tell the story. For this phenomenological study, I want to tell the story of the students I care about deeply, as they experience the subject I love, in the setting in which I have spent my career, the elementary classroom. Through *my* wanderings in the dark, I hope to shine light for others and gain insight for myself.

I hope I have not given an exaggerated impression, though. While the writing is difficult, it is also satisfying and illuminating. The depth of insight gained through writing cannot be compared to that gained only through experience. As van Manen (2003) explains, “In phenomenological human science, writing does not merely enter the research process as a final step or stage. . . .human science research is a form of writing. Creating a phenomenological text is the object of the research process” (p. 111). As a researcher, I first live the experience. Then, I am challenged and motivated to express the experience through text in a way that opens readers to share

in the experience, and also take from it something that will impact their future teaching and learning. More than just a reiteration of the experience, the work described in this phenomenological study attempts to place readers in an active role, a place in which they experience something of the inquiry-based classroom through the eyes of a 4th grader.

Hultgren describes the experience of a group of phenomenological researchers as they are learning phenomenology. She writes, “Phenomenology did something with all of us as writing became our place of dwelling” (Hultgren, 1995, p. 384). So beautifully stated. As writing becomes a place of dwelling, insight begins to open and understanding starts to surface. Not only is the reader influenced, but the researcher is forever changed. Van Manen adds:

To write/theorize is to bring signifying relations to language, into text. Language is a central concern in phenomenological research because responsive-reflective writing is the very activity of doing phenomenology. Writing and rewriting is the thing. (p. 132)

As I write, I begin to understand. I read, write, and rewrite. I add, arrange, and rearrange. I edit, delete and undelete. All the while I maintain a commitment to the goal of telling the students’ stories. When I sway from this, my effectiveness deteriorates. I must consciously focus on the lived meaning of their experience. Van Manen says, “The aim of phenomenology is to transform lived experience into a textual expression of its essence” (2003, p. 36). I must write of their essences, their essentials, their Heartsongs. And as I recognize myself as a part of the classroom community, I can legitimately articulate my part of the story as well, though with a profound commitment to hold back from dominating the text with my own viewpoint.

Van Manen offers additional insight:

To write phenomenologically is the untiring effort to author a sensitive grasp of being itself – of that which authors us, of that which makes it possible for us to be and speak as parent and teachers, etc., in the first place. (van Manen, 2003, p. 132)

In the context of this study, my untiring effort must be geared toward the creation of a child-spoken text. This does not mean a child-centered rendering which would give deference to the child as a central influence in the classroom, but rather, a handing over of the content of the text to the voices of the children in the study. Ultimately, should they read the text, they would clearly see their lived experience expressed, yet also find insight not grasped during the actual experience. In her poem, *Surprise*, child poet, Beverley McLoughland, captures the essence of a phenomenological rendering:

The biggest
Surprise
On the library shelf
Is when you suddenly
Find yourself
Inside a book
(The hidden you)
You wonder how
The author knew. (McLoughland, as cited in Heard, 1999, p. 35)

5) *Maintaining a strong and oriented pedagogical relation to the phenomenon*

... as we speak or write (produce text), we need to see that the textuality of our text is also a demonstration of the way we stand pedagogically in life. It is a sign of our preoccupation with a certain question or notion, a demonstration of the strength of our exclusive commitment to pedagogy that animates our interest in text (speaking or writing) in the first place. (van Manen, 2003, p. 138)

Notice in the heading above, van Manen does not merely call the researcher to “maintain a strong and oriented relation to the phenomenon.” The addition of the word *pedagogical* demands an increased level of commitment and attention on the

part of the researcher. The term *pedagogy* is one of the most frequently used terms in education and, like the term *inquiry*, has multiple shades of meaning. *Webster's New World Dictionary* (2001) defines pedagogy as “the profession or function of a teacher” or alternatively, “the art or science of teaching; especially instruction in teaching methods” (p. 1061). Gore (1993) shares a similar definition with an added twist:

What is meant by the term “pedagogy”? Etymologically, the term refers to the science of teaching children. Some have called for a strict application of the term pedagogy to the teaching of *children*, which has led to the emergence of a body of educational literature on “andragogy,” the science of teaching adults. (p. 3)

Van Manen (2003) offers an explanation of the term *pedagogy* in more phenomenological terms:

Pedagogy is not something that can be “had,” “possessed,” in the way that we can say that a person “has” or “possesses” a set of specific skills or performative competencies. Rather, pedagogy is something that a parent or teacher continuously must redeem, retrieve, regain, recapture in the sense of recalling. Every situation in which I must act educationally with children requires that I must continuously and reflectively be sensitive to what authorizes me as a pedagogic teacher or parent. (p. 149)

What is the difference, then between a teacher and a pedagogic teacher? How can one distinguish between acting educationally and teaching? With van Manen’s description of pedagogy in mind, what is the meaning of this phrase found in the 5th research activity: *pedagogical relation to the phenomenon*? The word meanings imply a connection or association to a phenomenon with regard to teaching. Considering the study of the lived experience of 4th graders in the inquiry-based space science classroom, the phrase suggests as a researcher I should attempt to maintain a teaching mindset as the children’s experiences unfold. I should allow myself to be

teachable as I approach the experience. I should strive to maintain an openness to my students' questions and maintain a sensitivity to their learning in the inquiry-based classroom. And, I should make myself available to my students as a teacher and a learner.

Van Manen states that the pedagogical relation to the phenomenon must be both strong and oriented. What is implied here? What does he mean by "strong?" Van Manen (2003) says, "A strong pedagogic orientation requires that one reads any situation in which an adult finds himself or herself with a child as a pedagogic situation" (p. 152). In other words, in the course of this phenomenological study, any occasion to interact with children should be considered an opportunity to teach, to convey knowledge, to consider children's pedagogical needs, to "let learn." Van Manen reminds us that "Too often pedagogic concerns tend to be reduced to political ones while the question of what is good for children rarely gets raised" (p. 142). I must remain determined to consider what is best for children as a pedagogic priority. I must consider every experience as a possible teaching and learning encounter for both the students and myself, and not allow distracting circumstances to stand in the way of providing pedagogically appropriate activities in the space science classroom.

And what is the meaning of the term *oriented* in the context of the statement, "maintaining a strong and oriented pedagogical relation to the phenomenon?" To *orient* suggests moving toward a particular reference point. Van Manen writes:

To say that our text needs to be oriented in a pedagogic way is to require of our orientation to research and writing an awareness of the relation between content and form, speaking and acting, text and textuality. To be oriented as researchers or theorists means that we do not separate theory from life, the public from the private. We are not

simply being pedagogues here and researchers there – we are researchers oriented to the world in a pedagogic way. (p. 151)

As a researcher, then, I am called to orient my focus and energy toward the participants in the inquiry-based space science classroom with a heart and mind to teach, and to be teachable. I must be both taught from the experience and committed to teach through the experience.

Looking to the research activities collectively, I am called to approach my chosen phenomenological study with abiding passion, a commitment to reporting concrete experiences rather than theoretical suppositions, and a determination to search for the essence of those experiences, with a tenacious devotion to writing and rewriting until the hidden is made known, doing so because my teacher's heart would not allow any less. Such a calling is challenging to accomplish, yet difficult to resist.

6) Balancing the research context by considering parts and whole

We recall the hermeneutical rule that we must understand the whole in terms of the detail and the detail in terms of the whole...it is a circular relationship... The anticipation of meaning in which the whole is envisaged becomes actual understanding when the parts that are determined by the whole themselves also determine this whole. (Gadamer, 1960/1989, p. 291)

In a practical sense, van Manen (2003) calls the researcher to view a phenomenological study from multiple vantage points. He writes, "It is easy to get so buried in writing that one no longer knows where to go, what to do next, and how to get out of the hole that one has dug. At several points it is necessary to step back and look at the total, at the contextual givens and how each of the parts needs to contribute toward the total" (pp. 33-34). Considering, once again, the dynamic interplay of the research activities, it is easy to see how a research study dependant on

intense personal passion, extreme commitment to communicating life as lived, and relentless writing and rewriting demands could lead one to lose sight of the overall outcome. I find myself, all too often, swept up in a particular thought, writing myself down a rabbit hole, before I realize I am, again, lost in the dark. Van Manen (2003) gives greater detail:

But as one engages in the *ti esten* [what is it?] question, there is the danger that one loses sight of the end of phenomenological research: to construct a text which in its dialogical structure and argumentative organization aims at a certain effect. In other words, one can get so involved in chasing the *ti esten* that one gets stuck in the underbrush and fails to arrive at the clearings that give the text its revealing power. (p. 33)

Gaining and retaining focus on the desired outcome of the study is critical to success. My overall desire is to tell a story to educators that will captivate their imagination and influence their teaching by exposing the lived meaning of 4th graders' experiences in the inquiry-based space science classroom. Components of that story include parts from each of the research activity descriptions. As I ponder the importance of considering both parts and whole, my attention shifts as I am reminded of a quote from Gadamer (1960/1989):

Only by forgetting does the mind have the possibility of total renewal, the capacity to see everything with fresh eyes, so that what is long familiar fuses with the new into a many-leveled unity. (p. 16)

Ultimately, this is what is called for in phenomenological work: To see with fresh eyes, report what is lived, and bring meaning to experience through a well-crafted text. Put in these terms, the work does not seem overwhelming until I consider the immensity of the journey.

In *A Walk in the Woods*, Bill Bryson (1998), describing his planning for a through-hike of the 2,160 mile Appalachian Trail, writes, "...I bought some books and talked to people who had done the trail in whole or in part and came gradually to realize that this was way beyond – way beyond – anything I had attempted before" (p. 4). Like Bryson, I ponder the long journey as I seek to answer the essential question: ***What is the lived experience of 4th grade students engaged in the process of space science inquiry?*** With so great a challenge, I ask, "How can I accomplish so daunting a task?" In this instance I will accept encouragement from my own pen. In an address to elementary teachers I implore:

Use the wisdom you have brought to the field of education. Be both patient and persistent. Trust the children. Allow them to exercise their gifts. (Horne, 2007b)

Good advice. Now I must take it to heart! Now I must live it.

Finding the Right Space and Place: A Description of the School Site and Classroom

In fact, when we journey back to the same place, the place itself need not be strictly the same; it would even be bizarre for the place to be altogether unchanged. We know it as different even as we return to it as identifiably (but not identically) the same... More than mere backdrop, places provide the changing but indispensable material medium of journeys, furnishing way stations as well as origins and destinations of these same journeys. (Casey, 1993, p. 274)

For a phenomenological study to be successful, not only does the researcher need to have a deep commitment to the objectives of the study, but also, especially in the case of working with young children in school, the researcher needs an open and positive relationship with the school administration, teachers, and community as well as with the students. This truth cannot be over emphasized. I want to be an advocate for giving children voice both in the classroom and through the text produced through

this research project. To maximize this possibility, the right space and place is required.

In my current position as curriculum specialist for elementary science and math, I work at the central office for a public school system, which means I have little day-to-day contact with students in their learning environment. Fortunately, I was welcomed back to conduct this formal study in a school where I have long standing relationships with the administration, teachers, and families. These relationships allowed me to re-enter the school community with an established level of trust, and a greater chance for success.

While my reputation was well established within the school and community, I did not know the 4th grade teachers who would be teaching the space science unit at the school. Because they use a departmental model for instruction, two of the four 4th grade teachers teach only language arts and social studies; the other two teach only math and science. One of the two science teachers, Mrs. Z, was identified as the only possible candidate to participate in this study since the other science teacher had not yet received tenure. I met with Mrs. Z on several occasions to explain the research project and see if she would be comfortable collaborating with me throughout a formal research study. She enthusiastically agreed to be involved, remaining curious and engaged throughout the planning and implementation of the study.

Description of the School

The public school site in which I conducted my study is one of 36 elementary schools in a suburban area in central Maryland. This elementary school was built in 1974 with an “open” floor plan providing space for a capacity of 488 students. There

are five portable classrooms in addition to the main building to support the current student population. The physical appearance matches its age, though the building is well kept and clean. Its hallways are “wallpapered” with student work providing a warm and inviting atmosphere. The campus is shared with the community high school with the middle school campus less than a mile away. A new addition, under construction throughout the study, will relieve overcrowding and also provide the school with a new cafeteria, gymnasium, and office area. The plan also provides a new larger parking lot and playground.

School Vision and Mission Statements

The educational programs at the school are designed to meet all students’ needs and support the school mission and vision. The school mission statement is: “Where everyone succeeds through quality learning for all.” The school vision states:

W Elementary is dedicated to preparing all our students to meet the demands of an ever-changing society. We believe all children can succeed; therefore, we hold every student to the same national, state and local standards of excellence. We strive to help each student meet these challenges with enthusiasm and reach his or her full potential. We are committed to providing education that is multicultural, embraces diversity and emphasizes the pillars of character (trustworthiness, respect, responsibility, fairness, caring and citizenship) shared by society as a whole.

W Elementary is devoted to family involvement and encourages all members of our learning community to collaborate with us in decision making, problem solving and school improvement.

When students leave W Elementary, they possess the skills, knowledge and attitudes to succeed in the future.

Science Related Activities

W Elementary is designated as a Maryland Green School. In order to become a Maryland Green School long lasting partnerships must be established with

organizations and other schools in the community for the purpose of obtaining and maintaining this status. One such partnership is with the adjacent high school. High school students and elementary school students participate in joint classroom lessons and outdoor planting activities. Teachers from both schools meet regularly to plan activities to support the Schoolyard Habitat program and environmental education activities. The elementary and high school students work together to learn about environmental issues and create outdoor habitats on the school grounds by planting trees and other plants. They collaborate to write a Nature System newsletter to inform the community about the goals and achievements of the teachers and students involved in the program, as well as to inform the community about environmental issues. Parents also have generously supported the school's Schoolyard Habitat Program by donating supplies, time, and personpower. Other partnering organizations include the Potomac Conservancy, the Monocacy Watershed Alliance, the Catoctin Watershed Alliance, and the Community Commons.

The school community also has demonstrated a longstanding tradition of involvement and success in the Space Day Design Challenge Program (<http://www.spaceday.org>). Over a period of seven school years starting in 2001, at least one team of students has represented the school as winners in this national competition, receiving honors at ceremonies in Washington D.C. In the 2005-2006 competition, I coached a team of 5th graders from the school who won "Best Overall" in the nation for their grade level.

During our trip to Washington D.C. the students met a number of astronauts and other influential people involved in the space industry. Ironically, it was not the

opportunity to shake hands with John Glenn, the famous astronaut who stood front and center in the space race of the 1960's, that captured the students' attention as much as another kind of space race. During our multi-day trip to Washington D.C. I was challenged to a footrace with the fastest student in 5th grade. Winning that race gave me more significance in the students' eyes than the accomplishments of any astronaut past or present. Fortunately I also had enough insight to lose the rematch race held at the school weeks later in front of the whole 5th grade class.



(Image 3.1 Space Day race, May, 2006)

Description of the Student Population

Of the 537 students enrolled in W Elementary School during the study, a breakdown of student demographics is as follows: 347 white, 112 African American, 25 Asian/Pacific, 2 American Indian/Alaskan, and 51 Hispanic students. The percentage of subgroups of students include: 29.5% Free and Reduced Meals (FARM), 4.3 % English Language Learners (ELL), and 8.1 % Special Education. There are 274 males and 263 females. The overall mobility rate is 14.4%

School-wide, class sizes for each grade are: Grade 1 – 111 students, Grade 2 – 108 students, Grade 3 – 113 students, Grade 4 – 97 students, and Grade 5 – 108 students. The school maintains a satisfactory rating in attendance with a daily average of 95.9%.

There are 24 students in Mrs. Z's morning class. The student conversants have math and science instruction in the morning with Mrs. Z, then go to a different teacher in the afternoon. Of the 24 students, all were given the opportunity to be a part of the study, and 20 received parent/guardian permission to participate.

School-wide, student demographics have changed over the past several years. Since 2003 the number of FARM students has increased from 10% to 30%, the number of African American students has increased from 9% to 22%, and the number of Hispanic students has increased from 4% to 10%. The special education population has stayed constant with an average of under 10%. Increases in the number of students in these targeted subgroups have been dramatic. The school continues to narrow the achievement gap and meet the state of Maryland's adequate yearly progress (AYP) requirements.

School-wide demographics compared to student conversants in the study are as follows: 64% (347) white students school-wide and 75% (15) white conversants; 21% (112) African American students school-wide and 20% (4) African American conversants; 9% (51) Hispanic students school-wide and 5% (1) conversant in the study. School-wide, 29.5% (158) of students receive Free and Reduced Meals (FARM), and 25% (5) of the students participating in the study. There are twelve male and eight female students who participated in the study. All of the parents/guardians of participating students gave consent for their children to stay in the study and each student assented to stay in the study for its entirety.

The Classroom Layout

Twenty-four students fit rather snugly into Mrs. Z's classroom, a corner room with temporary floor-to-ceiling walls reaching up to a 12-foot-high drop ceiling with florescent lighting. The room is situated adjacent to the busiest location in the school. There are no doors in the classroom. Instead, there are three wide floor-to-ceiling openings. What was once an open-school design has been modified to make the classrooms more conducive to learning. Ironically though, Mrs. Z's room offers little shelter from distractions due to its central location. Just outside the northwest end of the room there is a set of glass double-doors leading to the playground. No natural light enters through these doors due to the plywood roof over the entrance that protects children from falling debris from an ongoing renovation at the school. A five-foot gap exists in the wall near the glass doors allowing students the opportunity to see every person that comes in and out.

Near the northeast corner of the room, on the east wall, there is another doorway, located a few feet from a bathroom. During a typical day, this bathroom is used by about 150 boys. This opening allows for an easy view of the stream of foot traffic going up and down the hall to the outside doors, the bathroom, and the nearby computer lab. This becomes especially problematic during lunch shifts as hundreds of students move past the large openings to and from lunch and recess.

In the southwest corner of the room there is an opening to an adjoining 4th grade classroom. Next to this opening there is a window, covered with plastic and plywood, behind which a portion of a new addition is under construction. While the plastic and plywood do a decent job of blocking the view, they do not mute the

sounds of banging, drilling, and sawing that frequently emanate from behind the curtain.

Each student has his/her own desk and chair. The desks are clustered into groups of four to six together forming teams or “tables.” The front of the room has a chalk board and a projector screen, which blocks the view of the chalkboard when pulled down. About eight feet from the front wall, awkwardly placed in the middle of the room, there is a technology cart, a metal table on wheels that houses a projector, document camera, DVD player, and speaker. A mass of wires runs across the floor to a nearby wall outlet through a rubber wire guard. This arrangement keeps the cart fixed in this location. While it provides a means to use various electronic applications with the class, it also creates a barrier or obstacle near the center of the room. When seated at their desks, the 24 students in the class are situated in a cramped space with little room for movement between the desks and other furniture.

At the back of the room Mrs. Z’s desk is in one corner, with a reading table near a whiteboard mounted to the wall nearby. The individual desks are oriented in groups in such a way that students can turn themselves in their chairs with little effort to get a view of the front screen or the back whiteboard.

The tan and grey panel floor-to-ceiling interior walls are overlaid with colorfully decorated bulletin boards and posters containing a variety of educational cues, student work, and other information relevant to the current units of study. The science-themed bulletin board contains space related pictures and posters.

The room is small because it was tacked onto the end of a long line of rooms carved out of open space. Clearly this room received the short end of the measuring

stick when the rooms were marked-out since all the others in the row have significantly larger floor space.

I recorded several observations in my journal in an attempt to capture the students' reaction to their physical setting:

The word resilient comes to mind when I think of the students in my 4th grade class. I walk through mud to get into the building, then make my way to the classroom where drilling and banging can be heard in the background. The wall on the far side of the classroom has a huge plastic covered hole that leads to the new part of the building still under construction. Water regularly leaks between the old and new. This goes on for months – the entire time of my regular visits. Never once does a student complain or mention anything about it. Conditions I find distracting or simply out of my usual experience mean nothing to them. (Horne, 2010, from reflective writing)

When large crowds of students marched past the room on their way to lunch, I would turn or pause, distracted by the constant interruption. Meanwhile, the class would sit patiently, waiting, unmoving, unwavering. The conditions appeared to have no impact on the students. I asked Mrs. Z her thoughts on the distractions. She acknowledges that the situation is not ideal, but at the same time accepts it with a shrug of the shoulders and a smile. Perhaps it is because of her accepting nature and relaxed attitude that she was given this room in the first place.

Overview of the Study in the Inquiry-Based Classroom

By using inquiry skills, students learn how scientists investigate the natural world; by applying inquiry skills to their own learning, students develop a deeper understanding of underlying scientific concepts and principles. Equally important, science inquiry encourages students to form their own ideas based on direct observation, rather than accepting the ideas of others. (*Experience Science: Space Teachers Guide*, 2007, p. x)

Standards-Based Curriculum

According to district guidelines, 4th graders in the school district are to receive science or social studies instruction each day for approximately 40 minutes. Ninety days of the 180 day school year are devoted to instruction in life/environmental science, earth/space science, and physical science. Commercially produced kits of materials are housed in the schools, along with accompanying teacher guides and district-produced electronic curriculum maps that explicitly connect the *Maryland State Curriculum* (2008) standards and indicators to the commercially produced lessons.

The breakdown of science instructional modules for 4th grade within the district is as follows: The *Houghton Mifflin Experience Science: Light* module is taught for 15 days; the *STC Motion and Design* module is taught for 25 days; the *Houghton Mifflin: Classification* module is taught for 30 days; and the *Houghton Mifflin Experience Science: Space* module is taught for 20 days. The focus of this study, the *Space* module, started in January, 2010, about half-way through the school-year.

Inquiry-Based Pedagogy

The space science module, *Houghton Mifflin Experience Science: Space* provides the primary source of instructional materials for the 20 lessons designed to be taught during a 4-6 week period (see the Time Management Guide in Appendix B). Throughout the lessons, Mrs. Z and I provided space science content while orienting students to an inquiry-based pedagogy. Portions of the *Houghton Mifflin Experience Science: Space Teachers Guide* (2007) served as a reference for an

inquiry approach. During inquiry-based discussions, questions were presented to the group followed by classroom conversation. Here is a sample of questions used:

- Why does it get dark at night?
- Why is it colder in Maryland in the winter and warmer in the summer?
- Why does the moon appear to change the way it looks?
- What is inquiry based science?
- What do you wonder about space?
- What if there was no moon?
- What questions do you have about space that have not been answered?
- What space science vocabulary words do not make sense?
- What is it like in an inquiry-based classroom?

Holding whole group class conversations on a variety of content questions as well as inquiries into inquiry allowed time and space for student thinking to develop and interactions to take place. Students not participating in the formal study participated in all the same classroom activities, but their comments were not used as part of my analysis. Field notes written during and after instruction served to document details of student conversations during instruction.

Student Writing

Often educational researchers like to ask children to write about their experiences or to keep a log or diary and they end up being somewhat disappointed with the material they were able to generate from children in this way. Writing forces the person into a reflective attitude – in contrast to face-to-face conversation in which people are much more immediately involved. This reflective attitude together with the linguistic demands of the writing process place certain constraints on the free obtaining of lived-experience descriptions. (van Manen, 2003, p. 64)

Though student journal entries and other student work samples do not always yield the most in depth look at the students' lived experiences, sometimes carefully crafted writing assignments can reveal amazing insights. Throughout the course of the

study I asked students to respond to a number of questions in writing. Here are a few examples:

- What do you wonder?
- What is it like to participate in the Samoan Circle?
- Write about your favorite subject.
- What space science vocabulary still doesn't make sense to you?
- What is the meaning of inquiry to you?

I collected written work from all students in the classroom, but only responses from students whose parents gave consent and students who assented to participation were used in my analysis (see Appendices C and D for examples of student responses).

The Schedule

My first official visit to the classroom was during a typical cold morning during the first week in January, 2010. After an introduction, discussion, and a thorough explanation of the research study as well as a description of the space unit I would be teaching, I left behind the IRB forms necessary for participation in the study. Mrs. Z assured me she would handle the distribution and collection of all the signed forms (see the Parent Cover Letter – Student Conversant in Appendix E, Parent Consent Form – Student Conversant in Appendix F, Student Assent Form – Student Conversant in Appendix G). A few weeks later, all but four of the parents/guardians of the students had agreed to allow their children to be a part of the study. These students gave assent as well. The group of twenty conversants was set.

The time-frame for instruction was right before lunch each day from 11:30 to 12:15 p.m. My first day of teaching was January 25, 2010. We were about two weeks into what was to be a six-week time block when the forces of nature struck on

February 5, 2010. We were inundated with what President Barack Obama, during a media interview, called “snowmageddon.” Several locations in Maryland received over three feet of snow. Within the community where the study took place, snow totals were closer to 40 inches.

School did not resume until mid-February. By then, high-stakes testing for math and reading were just weeks away and Mrs. Z called me in to negotiate a change of plans. We had originally intended to complete the unit of study sometime in early March. Instead, Mrs. Z asked that I allow her to shift gears to provide time for preparation before testing. Testing took place from March 8th until March 12th. The following week Mrs. Z resumed science instruction while I was away at a conference.

The gap in science instruction lasted about a month. In retrospect, I wondered about the impact on student learning considering the length of time and the level of momentum lost in the long break. During the last week of March I was fortunate to observe and question students as they gave presentations on their planet research. I was also able to adjust my schedule to teach several more lessons, including a 3-D Scaled Planet Lesson (a personal favorite), which served as a culmination for the students’ research. By the time I had finished the first series of group conversations in early April, Mrs. Z had brought the study of space to a close.

In summary, I taught ten lessons and spent an additional week hearing the students’ presentations on planets. Mrs. Z taught the other ten lessons in my absence, for a total of five weeks of instruction, delivered over a nine-week period, which included a four-week break.

The Conversants in Conversation

In our pedagogical lives with young people we are actively and immediately involved in a manner of consciousness (with mind and body, head and heart) that only later is open to true reflection. (van Manen, 1991, p. 109)

Groups of varying sizes moved to a separate location within the school to participate in small group conversations lasting no longer than 30 minutes each. I facilitated the conversations, prompting when necessary with questions that led to relevant conversations about their experiences in the inquiry-based space science classroom. Conversations can head in many different directions so I used a series of prompts ready to get the conversations started. Here are several examples of the questions that prompted our inquiry:

- What is inquiry-based science to you?
- Describe what it was like when you participated in _____.
- What is the meaning of science to you?
- What is the meaning of space science to you?
- What was one of the most engaging experiences you had in the space science classroom? Tell me what that was like for you.
- Did you ever feel confused or unsure in the space science class? If so, please describe your experience of confusion. What didn't you understand?
- Are there questions you still wonder about? Let's wonder together about them.

At the close of every conversation, I drew the same conclusion, thinking: "It is not enough! I need more time. They still have so much to say. Their questions have not all been addressed. There are so many unanswered inquiries." The conversations left me exhausted and exhilarated. The feeling is very much like that of a classroom teacher not willing to accept that no school-year is ever long enough to get everything in! By June I was still calling students together for more conversations, scrambling to spend as much time as possible with them before the school-year draws to a close.

Some meetings are seemingly more productive than others, though each conversation presents a new opportunity to gain insight and capture the essence of the classroom experience from the conversants. Down to the very last meeting, the conversants never lost their zeal for our time together.

By the end of the school-year, I was able to participate in twenty separate conversations consisting of just over five hours of recorded and transcribed conversations held over several months. Nineteen of these were student conversations and one was with Mrs. Z, the classroom teacher. The groups ranged in size from one-on-one student conversations to a group of seven students. Overall, seven student conversations were one-on-one and twelve were groups of between two and seven students conversing with me. Each of the one-on-one conversations was held by student request. Decisions about who to group together and when to meet were largely circumstantial, though I intentionally held both mixed gender and same gender conversations. Overall, five groups were same gender and seven were mixed. Of the one-on-one conversations, four were with female students and three were with male.

Group discussions ranged in length from a little less than five minutes to one conversation lasting over 30 minutes. The average length of student group conversations was just under 20 minutes. The average length of one-on-one conversations was just under 7 minutes. Mrs. Z and I had one recorded conversation at the end of the school year lasting about 30 minutes, then, a full year after the beginning of the study, in January 2011, she and I sat down again for another half hour conversation.

Classroom Teacher Profile

So I see my children growing from this experience, and asking more questions, and being more actively engaged. So it's been really beneficial for them as well as myself, learning how to embrace it [inquiry] in my classroom. (Conversation with Mrs. Z, June 8, 2010)

As the study concluded, Mrs. Z completed her third year as a math and science classroom teacher at the school. Before coming to the school district, she completed her undergraduate degree at the University of Maryland, College Park. She is currently working towards achieving a master's degree in Educational Leadership from a local university. During the past several summers, she has enjoyed working at a children's camp in Delaware.

On the school website, Mrs. Z shares her profile. She writes, "My husband teaches fifth grade at [another school in the district.] We have two cats and a dog. I enjoy spending time with family and love to take pictures and go on long walks around the community."

Student Conversant Profiles

We pedagogues (teachers and parents) willingly open ourselves to children. This means that we do our utmost to understand what it is like to be in the world as a child. More concretely, I do my very best to understand the situation of this child. How does this child experience life in its multifaceted dimensions? (van Manen, 1986, p. 13)

Each child who chose to participate in the study offered his/her own personality, own way of being, and own essence. As with any group of individuals brought together and assigned the title, "class," they can take on a group identity within the confines of a phrase or two, to describe or stereotype the collective. Within that group identity, though, when adequate time and attention is given, each person stands out as an individual, utterly unique.

The group of conversants is rather large as such studies go, and the amount of time I was able to spend with the group and with the individuals was somewhat limited. Even so, I was able to make connections with each child and form bonds that are difficult to describe, and can best be understood by the experienced classroom teacher who has spent multiple years with a new group of students each year from August to June. My degree of experience with this group was much more limited than that of the classroom teacher, spanning only six months and including only dozens of hours, not hundreds. For each of the twenty conversants, I provide a brief description from Mrs. Z, my own observations, and quotes from each student to give a sense of their personality and their questions, using pseudonyms for name identification.

Georgia: Mrs. Z describes Georgia as talkative, a social butterfly, involved in and out of school, and a leader. Even as I first got to know Georgia, she always sought out my attention, coming up to me to say hello or ask a question as I entered the classroom and often following me to the door as I left. Georgia writes, “My favorite subject is science because it is fun because you can make experiments.” On a personal note, she writes, “I have three cousins and a sister. Guess what. I never saw my sister because she is in El Salvador.” Even in June, still wanting to know, she asks, “How many planets are there now since they just found dwarf planets?” (Conversation 16, June 10, 2010). Her curiosity never waned throughout the study, demonstrated by a constant stream of questions, sometimes delivered to my back as I headed out of the building.

Sasha: According to Mrs. Z, Sasha moved from another school in the district in October. She comments that she is very social and sometimes demonstrates a

negative attitude. I observe Sasha to be the kind of student who questions many of the structures of school, starting many questions with, “Why do we have to...?” While challenging, I find her to be smart and curious.

Sasha asks, “Like I don't get how like there, the gravity in it, the gravity on planets. And like in space because if there's no gravity in space, if there was—if there's no gravity in space, wouldn't the planets just fall? (Conversation 13, June 10, 2010). Questions like this came frequently, indicative of her interest in always wanting to know the reason why.

Chad: Mrs. Z calls Chad, “great!” She states that he has stepped up academically since the start of the year. His mom is involved in school. He is fun and tunes into adult comments other children may not catch. I observe Chad as a quiet student, thoughtful, and a deep thinker. He always has a knowing look in his eye. Chad writes, “My favorite subject is science because of the projects. You should know that I like baseball.”

Chad poses the question, “Will it [*The New Horizons Space Craft*] come back to earth?” (Conversation 3, March 30, 2010). He asks such questions because he truly wants to know, and he also wants me to know that he is interested.

Gregg: Mrs. Z notes that Gregg is not focused, but he loves science. During most other times of the day he participates very little and often does not accomplish his work. When I observe Gregg, he is always focused, and has endless facts to share about space. Occasionally he will pose a question, but he is much more prone to answer than to ask. Gregg says, “My favorite subject is science.”

Gregg comments, “I’m wondering if there’s a black hole coming near the planet” (Conversation 5, April 1, 2010). Such questions from Gregg are common, showing his deep interest in the wellbeing of the planet, the future of civilization, and an exaggerated concern for his own safety.

Ella: As described by Mrs. Z, Ella is a strong student, but she lacks confidence. “She second-guesses herself which effects progress and she often gets frustrated.” As I get to know Ella, I see a very curious student with great enthusiasm. You can see her enthusiasm as she describes the Samoan Circle activity. She states, “It was really fun because you got to interact, like standing up. And, being able to talk about stuff!! And we got to be recorded! You got to answer questions and stuff. I love it!!” Describing herself she writes, “My favorite subject is math, science, language arts. Why: because math is fun and you learn math facts. Also L.A. is really fun!! ...I collect dolls. But their [sic] not regular Barbie dolls, they are \$30 - \$500!”

Ella, always full of questions, inquires, “My question is why are sometimes the clouds are pink or a different color? And, sometimes the moon is different colors and I wanna know why?” (Conversation 1, March 29, 2010).

Katrina: Mrs. Z says that Katrina’s mom only speaks Spanish. Katrina is bilingual. She is extremely quiet and big groups overwhelm her. I concur. Katrina does not speak to me for about a month. I am wonderfully surprised when she warmed up and began to share her thoughts, especially later in the year when we met in small groups to have a conversation. She has many questions and a strong drive to learn new things. She writes, “I want to learn more about black holes and dwarf planets...I want to learn more about it so I can understand it.”

She reports that her favorite subject is math, “because I like fraction and adding and subtracting and multiplying.” She also writes, “I have a mom, dad, 2 sister and me. You should know that I like basketball.” Curious Katrina states, “I still wonder why far away the stars blue are hotter than, than orange or yellow” (Conversation 6, April 8, 2010).

Karyn: Mrs. Z says Karyn is extremely quiet in class. She is closer with girls from other classes and acts like she is not part of the class. She does not participate very much in classroom interactions and discussions. I notice similar patterns. Karyn does not speak more than a few words to me throughout the semester. I question myself as to whether I am getting through to her. Eventually I am able to observe that Karyn is a careful listener. Even though she is rarely vocal, I begin to notice her level of concentration, eyes tracking the speaker whether still or in motion. Academically, she is successful in the space science classroom, another indication of her attentiveness. She describes the Samoan Circle activity as a positive experience. She writes, “Once I asked a question and it got answered so now I know the answer to my question. The Samoan Circle really helps you!” Though not social, she has a desire to learn. Also, to my amazement, Karyn writes a very lengthy letter to me at the end of the school-year. In part, she states:

Math is my favorite because math can help you a lot in your future it can help you do better with dividing, X, -, +, I got better with math by practicing math during the year and the summer so Im [sic] ready for all the years I have left! ...Im [sic] very active. I play a lot of sports. My favorite sports are softball and soccer. I also play vallyball [sic], tennis, skating, swimming, and lots other but I dont [sic]have engnoth [sic] time so that’s something you should know about me!

During a conversation about the *New Horizons* mission to Pluto and beyond, Karyn asks, “When will the spaceship pass Jupiter?” (Conversation 7, April 15, 2010). Her question provides evidence that she listens closely.

Brenda: When asked about Brenda, Mrs. Z has nothing but positive comments to share. She states, “I love her. She’s sweet, a hard worker, and respectful. She encourages kids to make better choices. She is a wonderful role model.” I notice that Brenda is a very conscientious student, while at the same time rather quiet. Her comments about “inquiry” are indicative of her actions in the classroom. She writes, “I think it means asking questions, learning new things. I ask questions in Mr. Horne’s class. I learn new things and sometimes examine things.”

Brenda says, “My favorite subject is science because whenever I am in science class, I get a “cool” feeling. I have 4 sisters and 2 brothers.” During a conversation, Brenda shares, “I’m still wondering how many stars are in the sky” (Conversation 5, April 1, 2010). Though this is not a question that is easily answered, it is one that reveals her level of curiosity.

Doug: Mrs. Z reports that Doug has numerous behavior issues including aggression and outbursts of anger. He takes criticism very poorly. Because of difficulty with organization and planning, he keeps a special calendar to track assignments. I notice that during space science instruction, he attempts to make jokes and clown around while I am teaching, especially during the early weeks. Over time, this behavior diminishes and he is often quiet and appears to be attentive. In answer to the question, “What is the meaning of inquiry to you?” he writes, “Make me feel happy and fun.” He also states, “My favorite subject is science. I want to know more

about space.” Science is a subject that brings out the best in Doug. He truly wants to know more about space and this drive seems to keep him focused.

Jacob: Mrs. Z says that Jacob is an amazing kid! He is a deep thinker, expressive, and loves to take on projects. I observe that he asks great questions and is very responsible. When asked, What was it like to participate in the Samoan Circle? Jacob states, “Well I like it because we can talk about and discuss about space. Also we can ask questions about space and we can discover about space. Lastly we can have fun. Also we can solve questions about space.” He also reports that, “My favorite subject is science because I can have fun.” I enjoy any opportunity to chat with Jacob. He never misses an opportunity to ask a question that had been on his mind. He’s the student who never takes his eyes off of you during instruction, an indicator of intense listening.

Brunden: By Mrs. Z’s description, Brunden sits back and is not a very hard worker, though he seems surprised when he gets in trouble for not working. He is satisfied to put little into his work. I observe Brunden as a joker or a class clown. He enjoys making funny comments and sharing funny stories whenever possible. He seems to enjoy the study of Space, if a tolerable level of attentiveness is an indicator, but Brunden is more interested in attention to himself than the content being studied. The following written comments are exemplary of his thoughts and attitudes: “Why do they call it the milky way, is it made of milk? Since Pluto is not a planet why don’t they blow it up?” He states, “My favorite subject is science because you get to learn about mold, plants, space, and moving objects... I like Fred Figglehorn but my friends and family don’t.” Fred Figglehorn is a fictional child with a dysfunctional

home life and anger management issues. The Internet videos have become very popular in recent years, especially with Middle School students.

Roy: Mrs. Z tells me that Roy recently moved with his family from overseas. He is a very positive student and is appreciated by his teachers and classmates. From my perspective, Roy is a smart and curious student who is always filled with questions. In every conversation we have, he seems to enjoy posing questions and discussing Space Science concepts. During class time, he is not always the first to raise his hand, but can frequently be observed leading his table group in animated discussions during small group time. Roy comments, “It was cool being in a Samoan Circle because you get to ask questions about space and discuss them.” He says he likes math and writing. When asked why, he states, “I’m good at it.” He later writes, “I remember that all the stuff in the solar system together isn’t bigger then are [sic] sun...I wonder what’s inside a black hole?”

Ethan: According to Mrs. Z, Ethan is a bright student and asks thought provoking questions. During my interactions with Ethan in small group conversation, he spends a lot of energy trying to be funny and gain the attention of his classmates. During classroom time, he is often very quiet and disengaged. He writes, “It was cool participating in a Samoan Circle. In a Samoan Circle you get to share your ideas to others. You can ask questions and people can answer the question you asked.” Ethan states that his favorite subject is reading. “I like reading because it’s fun to read about history and other stuff.” He also wants to be sure I know how much he likes doughnuts (perhaps because he caught wind of the famous end-of-the-year Krispy Kreme parties I have with my classes every year). He states, “My favorite donate [sic]

is a chocolate covered glazed donut [sic].” During one of our content based discussions, he shows a sincere interest, posing the question, “I wonder, how do planets form?”

Drew: Mrs. Z describes Drew as talkative and intelligent. I am impressed with his inquisitiveness. Drew often ponders questions of space and is excited to find answers. On more than a few occasions, in response to some description of a space phenomenon, he can be heard exclaiming, “Whoa!” A sense of wonder can often be seen in his eyes. He writes, “Being in an inquiring class is fun, learning stuff and getting to ask questions for research.” He has a passion for learning. He states, “My favorite subject is Social Studies. I like it because you learn about famous people back in the days.” One day he poses a fascinating question that reminds me of his desire to understand: “There is still one thing I wonder. If we didn’t have any gravity would the water fall off the Earth?”

Jacquelyn: Mrs. Z states that Jacquelyn is bright, has self confidence issues, and can be quiet at times. My observations of Jacquelyn reveal a very intelligent, curious student with a passion to learn. Her quiet nature transforms while in small group conversations, during which time she is animated and interactive with other students. She writes, “My favorite subject is writing because I love writing stories and paragraphs. I love writing! I have a sister in 1st grade ...and a “13” year-old brother... I play soccer and lacrosse and I loovvee Myokos, a Chinese restaurant.” Her most pressing space question, “I wonder, why are there planets?” This is a question she not only asks, but for which she also presses for answers.

Jonny: When asked about Jonny, Mrs. Z shares that he has multiple challenges including speech issues. He has been diagnosed with a form of autism and obsessive compulsive disorder (OCD). She states that he never does homework. I observe that Jonny is often absent. Socially, he struggles to fit in with the class and does not attend to social cues. His interest and fascination with space and knowledge of space concepts is vast, which gives him an increased level of credibility with his peers during space science instruction. He writes, “My favorite subject is space science because it has incredible [sic] information.” In summary of his interests, Jonny states, “I am 9 ½ years old. I like being tan. I like to sing, and I like playing Horse.” He poses extremely interesting questions and engages the class in wondering with him. For example, he asks, “I wonder if there is a different kind of life in space? I also wonder, can a planet in our solar system make an eclipse with other planets in our solar system?”

Reggie: Mrs. Z says that Reggie is disorganized and often does not do homework, though he is very bright. Reggie does not interact with me very often during class, though he seems to be listening intently. He is polite and more talkative during our small group conversations. He writes, “My favorite subject is math because I’m the best at it and second is science because your [sic] fun. I have 2 sisters. I like to skate board.” When asked to share any pressing questions, he states, “I’m still wondering what, if there’s any planet with living humans, or different animals.”

Cherry: Mrs. Z notes that “Cherry is a great reader. She is a talker and regarding her interactions with other students in the class she is dominating and

pushy.” I do not see these traits during my time with her in class or in conversations. When I am with the group, Cherry seeks out my attention, often looking for approval and asking multiple questions in rapid-fire succession. When asked about the meaning of inquiry, Cherry says, “I think it means like what it’s like being in Mr. Horne’s class.” She states, “My favorite subjects are Science and Language Arts because they are both so Awesome! ...I have 1 sister and 4 brothers.” In a note delivered at the end of the year, she writes, “Dear Mr. Horne, I will miss you over the summer! You were the best and smartest science teacher! Sincerely, Cherry. I love science!”

Jackson: Mrs. Z informs me that Jackson started the year very positive, having just moved from another state with his mother. During the fall he suffered a severe head trauma which impacted his behavior, causing him to be more aggressive. In my observations of Jackson, I did not notice any aggressive characteristics. He was curious and courteous during instruction and in our small group conversations. He tells me, “I got one sister who’s 27 and I like building stuff with anything I can find.” He has a curiosity about the mission to Pluto, asking, “When did they send the [*New Horizons*] spaceship?”

Sean: Sean has a twin sister in the classroom next door, according to Mrs. Z. She describes him as athletic and bright. I see Sean as one of the most curious students in the class, always interested in knowing more and demonstrating an insatiable passion for space science. When asked: What is the meaning of Inquiry to you? Sean states, “I think inquiry is a question or an investigation. Also it’s a discovery of information... I love it and also I’m learning a lot.” He also writes about

the Samoan Circle. He notes, “It was awesome to share what we had to say about the faces of the moon. It was even more fun talking to my friends.” Regarding his personal life, Sean tells me, “I have a lot of siblings: 1 brother and 4 sisters... Counting me, 6 siblings and 2 parents. I think you should know that I am going to love learning even more about space and I love soccer.”

Former-Student Conversant Profiles

While not part of the proposed plan for this study, a series of circumstances re-acquainted me with two former students who each played a role in foundational work for this study described in Chapters Two and Three. After realizing the wealth of relevant feedback several former students would be able to contribute towards the understanding of student experiences in the inquiry-based space science classroom, I worked to secure IRB permission to extend the parameters of this study to include conversations with them (see the Parent Cover Letter – Former Student in Appendix E, Parent Consent Form – Former Student in Appendix F, and Student Assent Form – Former Student in Appendix G).

During a planetarium show one evening at our school system’s science center, called the *Earth and Space Science Lab*, Aubrey introduced herself to me as one of my former students. Aubrey was a student in Mrs. V’s 4th grade class during the 2003-04 school-year (see references on pp. 55, 78, 80, 99, 100, 108, and 109). The students in the 4th grade space science class were part of a National Science Foundation study for which I was doing research at the time. That year I taught the space science unit with Mrs. V and also supported her and the student participants in a Space Day design challenge competition.

Aubrey has an amazingly vivid recollection of the experiences in the space science classroom, though the experience took place seven years earlier. I asked her if she was interested in being a part of a research study and she enthusiastically took the idea back to her parents. During our informal conversation at the planetarium show, she mentioned Paula, another former student from Mrs. V's 4th grade class and friend of hers who she thought would also have a lot to say on the topic of the inquiry-based classroom. Paula's father had previously made contact with me (see p. 161) so I took the opportunity to contact him to pursue the possibility of including Paula in this study. I discovered that Paula (see references on pp. 68, 69, 161, and 162) also has detailed memories of the 4th grade experience and was enthusiastic about sharing them. Several months later, and after obtaining IRB approval, I had the opportunity to have conversations with both Aubrey and Paula.

At the time of our 30 minute recorded conversation in April of 2011, Aubrey is a Junior at a local high school. She states, "I am involved academically and theatrically and extracurricularly and societally...So I think it's really cool that I get to come back and share the experiences and how fourth-grade science has impacted my life even in high school." In addition to her involvement in a number of programs at her school, she also serves as the president of her school's chapter of the National Science Honor Society. She is very enthusiastic about the opportunity to reflect on her elementary school experiences and share her experiences with educators through this work.

During a 30 minute conversation with Paula in April of 2011, she shares: "I want to major in environmental science and minor in marine biology, or do a double

major. I'm on the Envirothon team and in an environmental club.” She is also a member of the school’s chapter of the National Science Honor Society. She enthusiastically participated in the opportunity to share past space science experiences as well as her current circumstances and future goals.

Looking Ahead

In Chapter Four a phenomenological uncovering of the newly emerging themes from the study is discussed as the overarching phenomenological question is explored: **What is the lived experience of 4th grade students engaged in the process of space science inquiry?** The metaphor of light is used to illuminate student experiences in the inquiry-based classroom, revealing the actions and voices of students and their teachers as they discover space.

CHAPTER FOUR:

BY THE LIGHT OF THE COSMOS: ILLUMINATING THE INQUIRY-BASED SPACE SCIENCE CLASSROOM

Themes are the stars that make up the universes of meaning we live through. By the light of these themes we can navigate and explore such universes. Themes have phenomenological power when they allow us to proceed with phenomenological descriptions. (van Manen, 2000, p. 90)

The classroom experience is over, the data are collected, and now the next phase of the journey is ready to begin. As I press ahead, I seek bright illumination of the essential. I look for a luminous glow of light to guide me. I search for the radiant sun to reveal hidden insights in this quest for lived meaning. Instead, light of a more subtle nature is revealed.

Van Manen's metaphor in the quote above describes themes in phenomenological work as star light through which we can navigate and explore the meaning of lived experiences. With the metaphor in mind, consider that stars in the night sky can be observed simplistically as points of light on a black canvas. While far from a complete picture of the universe, the stars seen at night do give us a window into the observable universe in our indescribably small part of the cosmos. What we can see with our unaided eyes represents an amazingly minute picture of all that is out there. In the best of conditions on earth, we can see with our naked eyes only a few thousand of the nearest and brightest stars, all members of our Milky Way Galaxy (with one exception in the northern hemisphere, the Andromeda Galaxy – a group of nearly a trillion stars we see as a point of light). What our eyes *cannot* see includes billions of galaxies, each containing hundreds of billions of stars, not to mention countless other celestial objects. What we see in phenomenological research

must be accessible to our “naked eyes.” The work we do must be about “the things themselves.” In other words, the things are the stars that we see, not distant objects we have only heard about or for which we can only theorize.

The visible night sky, like the text of lived experience, at first appears as random, dull, and featureless, lacking any coherence or connection. But through careful analysis, fascinating discoveries start to appear. Differences in starlight can be very small, and only through detailed observation can subtleties of color and variations in brightness be seen. Likewise, it is only through painstaking phenomenological work that meaning shines through text as it is analyzed. The imagination of the ancients is often challenged in our modern view of the identified constellations. How in the world did they see an archer or a bull? One might think, “All I see are stars clustered nearby to one another in the night sky.” But, with patience and imagination, the pictures can start to come into focus. The line drawings, filled in with the creativity of the viewer, start to make sense. Phenomenological research is like this. Looking long and hard into the night sky, at what first seems like disconnected points of light, we finally are able to see outlines of a great serpent or mighty hunter. Through patience, careful observation, and persistence, the seemingly random words of the text take form and a beautiful picture comes into view.

In phenomenological work, themes unfold over time and through the process of listening, reading, writing, and reflecting. My first read-through of 190 pages of transcripts, capturing hours of student conversations, does not begin to reveal much of a story or pattern. Just like a fleeting glance into the heavens, I see little. Another night of viewing, including highlighting, note taking, and hand written commentary

brings more illumination. The pinpoints of light offer little by which to see. Even though the great expanse of darkness overwhelms them, the intense contrast helps to expose their light. Eventually, what once was 190 pages of points of light becomes 59 pages, sorted into initial categories, now seen as points of light that form groups, constellations, or pictures. Through further analysis the points of light take on a new appearance and begin to reveal a story. The stars are starting to reveal patterns. Several more long nights of observation (any astronomer will appreciate this analogy, especially imagining a cold night in the dead of winter) brings greater clarity and a little frost-bite. The observations involve reading, re-reading, highlighting, and more note-taking. A second and third round of thematizing brings even greater understanding. Still, I am cautious about claiming some great discovery. No astronomer would be so presumptuous.

Time spent studying transcripts of children's dialogue can be transformational and also can be tedious. Throughout the process, I continue to rely on the purpose of the work, as it grounds me with a focus on the task. In *The Tact of Teaching*, van Manen (1991) puts the task into proper context:

Most books on education are agogical. They direct themselves to the adults, to the parents or to the teachers, and not to the children. They preoccupy themselves with the question how educators (should) think, act, feel, and interact with children...this emphasis on the adult fails to consider how particular situations appear from the child's point of view, how the child experiences his or her world at home, at school, and in the community. (p. 11)

With a child's point of view remaining my center of focus, thirteen themes consolidate into five, and eventually become three. What was once a long gaze into a

sky interrupted by banks of clouds, only occasionally revealing stars, yields to a series of beautiful nights with open skies. The space is breathtaking!

Traveling at the Speed of Light: The Active Inquiry-based Classroom

From the astronomical point of view our solar neighbor is, at a distance of 93 million miles, extremely nearby. Its light, traveling at 186,000 miles per second, takes eight minutes to reach us, while a jet plane would take eighteen years to make the same trip. (Dubay, 1999, p. 135)

Staring into the night sky the viewer is witness to constant motion and outrageous activity. But, to recognize the amazing spectacle of motion and extreme speed, one must appreciate the make-up of the universe in which we live. As we gaze into the night sky, we are viewing into the distant past as light from stars approach us at 671 million miles per hour and from unfathomable distances. Proxima Centauri, for example, the closest star to earth (aside from our sun) is 4.2 light years away. In other words, it takes light, moving at such incredible speed, over four years to reach us. A light-year is the distance that light, travelling in a vacuum, moves in a 365 day period of time; about 6 trillion miles.

Even at 186,000 miles per second (671 million miles per hour; 6 trillion miles per year), it takes light from the Andromeda Galaxy, amazingly visible to our unaided eyes, 2.5 million years to get here. So, when we see Andromeda on a clear night, we are seeing light that started its journey before human existence.

What we perceive as light, is not quite what it seems. In reality, only one-tenth of the light spectrum falls in the category of visible light. Other beings, as well as scientific instruments, can detect forms of light our human eyes cannot resolve. The

nature of light, the fastest known thing in the universe, is quite unlike what we detect with our senses. As O'Donohue (2004) points out:

One of the great illusions of human vision is that there is stillness, yet what seems still to our eyes is in fact never still. The whole physical world is in a state of permanent vibration and change. Each object is constantly astir. The physical world is an electromagnetic field. Each thing is deftly aflow in the play of energy, namely, electromagnetic waves. The waves flow in different frequencies. Our eyes only pick up a small section of this vibrating wave-world: this is what we call visible light. (p. 86)

At speeds much slower than light, the earth is traveling around the sun at a meager 60,000 miles per hour, or about 1,000 times faster than highway speed. Because of the great distances involved, the observable effect is only detectable over time as the constellations come in and out of view over a period of months. As the earth turns on its axis at about 1,000 miles per hour (measured at the equator), it is easier to notice the movement of celestial objects across the ecliptic, with constellations, planets, and the moon rising generally in the east and setting in the west over a period of hours. Viewers of the night sky will agree that the most obvious examples of observable motion in the cosmos are the streaks of light sometimes seen flashing across the blackness of night. They are commonly known as shooting stars, though they are actually space debris speeding through our atmosphere, moving so quickly the friction causes these particles of rock and metal to burn brightly, briefly lighting the night sky.

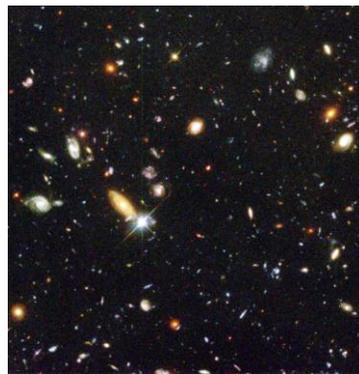
Space is not dull, static, or unchanging. Absolutely everything in the universe is in constant motion, so we refer to apparent motion as relative motion, a measure of any change in position of objects relative to other objects. While naked eye observations of the night sky require understanding to appreciate the sense of motion

taking place, telescopes have given us the opportunity to make better observations of the active nature of the universe. Close to home, the lifeless, static, yellow sun is transformed into a view of a cauldron of activity when viewed through special telescopic instruments. Even a look at the moon with a backyard telescope demonstrates to the observer the speed of the earth's movement as the view of the pitted surface of the moon quickly races out of view.

In recent years we have been treated to countless images of incredible beauty and mystery from the Hubble Space Telescope (HST). In 1995, just a few years into its service, the orbiting telescope was aimed at an empty portion of space far from the plane of our Galaxy and therefore "uncluttered" by nearby objects. What was discovered opened the window to a new perspective on the universe.

The January 16, 1996 NASA news release, titled, *Hubble's Deepest View of the Universe Unveils Bewildering Galaxies Across Billions of Years*, reports:

Representing a narrow "keyhole" view stretching to the visible horizon of the universe, the HDF image covers a speck of the sky only about the width of a dime located 75 feet away. Though the field is a very small sample of the heavens, it is considered representative of the typical distribution of galaxies in space because the universe, statistically, looks largely the same in all directions. Gazing into this small field, Hubble uncovered a bewildering assortment of at least 1,500 galaxies at various stages of evolution. (*Hubblesite* website, 2011)



(Image 4.1 <http://hubblesite.org/newscenter/archive/releases/1996/01>)

More recently, the Hubble Ultra Deep Field images revealed a peek into the universe as far back as 13 billion years. Light from the formation of the universe is now shedding fresh light on our understanding. Each day further discoveries are made, opening the field of space science to new insights. The universe is dynamic, changing, and moving.

Right here in the Milky Way Galaxy, on the 3rd closest planet from the sun, in a classroom of nine-year-olds, children are moving, learning, growing, touching, running, rotating, and revolving. They are not static. They are living in a space, learning about space, and experiencing space. Like the world of outer space, their space in the inquiry classroom is active and ever changing.

Doing

Implementing the *Standards* will require major changes in much of this country's science education. The *Standards* rest on the premise that science is an active process. Learning is something that students do, not something that is done to them. (National Research Council, 1996, p. 2)

An essential element of the inquiry-based classroom experience is the opportunity for students to be active participants in the learning process, not merely passive recipients of information. Learning is something students do! To “let learn” is the work of the teacher. The term *active* “implies a state of motion.” *Activate* is “to make active; cause to engage in an activity. *Activity* is “the quality or state of being active; action.” And *action* is “the doing of something; state of being in motion or of working” (*Webster's New World Dictionary*, 2001, p. 14). The inquiry-based classroom is a place where students actively engage in activities that activate action oriented access to understanding. But, as Dewey (1938/1997) points out:

The belief that all genuine education comes about through experience does not mean that all experiences are genuinely or equally educative...It is not enough to insist upon the necessity of experience, nor even the activity in experience. Everything depends upon the quality of the experience which is had. (pp. 25-26)

Jardine, Clifford, and Friesen (2003) reinforce Dewey's premise, stating:

Just "doing" can be as mindless as not doing at all. The *doing* of activity-based hands-on learning by discovery can remain as divorced from the contexts that give them meaning as any other kind of rote activity. (p. 102)

All doing does not automatically equate to learning. Of course not! But, from the students' perspective, what is it like to experience "doing" in the inquiry-based classroom? How do the students distinguish between rote activities and those with meaning? When students are asked to tell the story of the inquiry-based classroom, what do they reveal?

The language that dominates our conversations about the inquiry-based classroom includes terms such as: *experience, experiment, do, hands-on, visualize, physical, see, feel, touch, hold, and move*. These action oriented terms, seen in the context of our animated conversations, suggest not only activity, but also excitement, engagement and purpose. After a morning of instruction with Mrs. Z's class, I write, "Getting up, moving, and being active brings delight into the eyes of the students" (Horne, 2010, reflective journal). This simple observation has potentially profound implications. Is the inquiry-based classroom to be more of a place of doing or an experience of "something that is done to them" as the *Standards* (National Research Council, 1996) warn against? The *Framework* (National Research Council, 2011) offer fresh support for the act of doing:

The actual doing of science or engineering can also pique students' curiosity, capture their interest, and motivate their continued study; the insights thus gained help them recognize that the work of scientists and engineers is a creative endeavor—one that has deeply affected the world they live in. (p. 3-1)

A popular word used by conversants in reference to “the doing of science” in the space science classroom is *experiment*. This term is often associated with science, especially in the context of experimental design or the much maligned process, *the scientific method*: a formal and rigid set of procedures conducted to answer a specific scientific question. Stereotyped pictures of mad scientists conducting some sort of chemical “experiments” also are frequently depicted in popular culture to represent the activity of science. But during our conversations, students do not make specific connections to the scientific method or to any stereotyped references. They do, however, interchange the term experiment with experience. Students' ideas about experiments are actually far from the stereotype. For example, during one of our conversations the following interchange takes place:

Georgia: ...like, for science, when it's fun – it's fun because you get to like do experiments and [*Brenda interjects*]
Brenda: That's what I was gonna do. Experiments!
Georgia: You get to do experiments, like, you get to test things out.
(Conversation 8, April 16, 2010)

The reference to experiments here, defined by Georgia as an activity during which “you get to test things out,” is referring to the use of models in the space science classroom to explore a concept. Both Georgia's and Brenda's enthusiasm are unmistakable. Interestingly, the hands-on experience is described here as an “experiment.” *Webster's New World Dictionary* (2001) defines the term experiment as, “a) any action or process undertaken to discover something not yet known or to

demonstrate something not yet known; b) any action or process designed to find out whether something is effective, workable, valid, etc.” (p. 500). The definition captures Brenda and Georgia’s usage of the term in an interesting way. That which they are “testing out” is an understanding of the process of day and night. Essentially, they are using physical models to work out, concretely, a concept they are trying to grasp cognitively. The successful outcome of the “experiment,” in this case, is the degree to which the model generates an effective, workable understanding of the mechanism causing day and night, referred to as *rotation*. The hands-on “experiment” with the model allows the student to “discover something not yet known or to demonstrate something not yet known” by the learner.

Even more important, the activity provides a platform for students to learn in a way that challenges them to think, to ask questions, and to wonder, and entices them to desire to learn more. Dewey elaborates:

It is his [*the teacher’s*] business to arrange for the kind of experiences which, while they do not repel the student, but rather engage his activities are, nevertheless, more than immediately enjoyable since they promote having desirable future experiences...Hence the central problem of an education based upon experience is to select the kind of present experiences that live fruitfully and creatively in subsequent experiences. (Dewey, 1938/1997, pp. 27-28)

The “doing” classroom is a place of engagement that opens space for students to look forward to and seek out new opportunities to participate actively. One experience serves as a scaffold or progressive step to the next learning experience. In order for a teacher to develop learning experiences that successfully “live fruitfully and creatively in subsequent experiences,” careful and thoughtful attention must be placed on the children’s experiences, understandings, and questions. The challenge is to

remain attentive to and listen even more closely to our students throughout the learning process. Learning stops when students cannot be encouraged to ascend to the next level of understanding. As educators, our “race to the top” must be an active, highly motivated, collaborative act, with our greatest intention to move our students into deeper learning, resulting in greater achievement. We can only achieve such a lofty goal by paying close attention to how our students experience the world of school.

Visualizing

Sometimes I feel sure that I catch a faint glimpse of the goal I am striving for, but in another minute a bend in the road hides it from my view, and I am again left wandering in the dark! (Keller, 1903/2003, p. 350)

Helen Keller, born in 1880, became deaf and blind by nineteen months of age. Through the painstaking efforts and persistence of her own and through the same level of commitment and passion from her teacher, Anne Sullivan, Helen came back from darkness into “light” at the age of seven. The way in which she understood the world was based on her ability to hear and see with her mind, to imagine and visualize that which is unheard and unseen. In the quote above, Helen Keller describes a bend in the road blocking her line of sight. She says the bend “hides it from my view.” Then she says she is again left, “wandering in the dark.” What is she seeing? What does it mean for her “to visualize?” How does she learn to see without remembering ever having seen? What role does *visualizing* play in the experience of children in the inquiry-based classroom?

During hours of conversations, students use a number of terms to describe the active, hands-on nature of the inquiry-based classroom they have experienced. In the

following example, Jacquelyn uses the term “visualize” while explaining the value of using models or manipulatives in the learning process. This term catches my attention because of its repeated use in multiple conversations.

- Jacquelyn: You passed out these cool balls to pretend like they’re moons.
- Mr. Horne: Tell us about it, yeah that’s hands-on. How does that help you to learn, or does it?
- Jacquelyn: It does. We stood up and you said that that the man on the moon, it always faces the earth, like something staring at you, and it doesn’t go away.
- Mr. Horne: So how did the hands-on help you? Or did it? Maybe it would’ve been just as easy to read about in a book.
- Jacquelyn: It actually, like, you could visualize, you could hold it. (Conversation 1, March 29, 2010).

Jacquelyn uses the term visualize here in place of the term see. During the hands-on experiment, Jacquelyn and her classmates are encouraged to both see and touch, two powerful senses that can add depth of meaning to the experience. O’Donohue (1997) says, “Touch is one of the most immediate and direct of the senses... Touch is also subtle and distinctive and holds within itself great refinement of memory” (p. 74). I wonder how the use of multiple senses plays into the learning experience for children. In the case of Helen Keller, touch became the entry point into her mind that opened the world of language and thought to her.

Later in the conversation, Roy discusses the classroom experience, also using the term visualize:

- I think it’s better for you to see it, because if you’re just reading in a book and something you might not get, but you might understand it if you see what it does. For instance, you might say the earth goes around the sun while the moon rotates and orbits the earth, and you might not understand that, but when you see that and visualize that, see it going around and spinning, it’ll be easier to comprehend. (Conversation 1, March 29, 2010)

Visualize suggests something you “see” in your mind. Roy alludes to the idea that during the experience with models, he could both see the model and visualize the actual celestial event. Making connections between physical models and actual events is the intended purpose of such an activity. *Visualize*, from *visual* means, “to form a mental image of something not present to the sight, an abstraction, etc.” (*Webster’s New World Dictionary*, 2001, p. 1598). The hands-on experience with models in the inquiry-based classroom allows Roy to experiment with space science concepts in a visible, physical way, so that later he could visualize the process without the models and comprehend the concept with more concrete imagery. Roy’s comments about his experiences are reinforced by *The Benchmarks for Science Literacy* (American Association for the Advancement of Science, 1993) which state:

Physical, mathematical, and conceptual models are tools for learning about the things they are meant to resemble. Physical models are by far the most obvious to young children, so they should be used to introduce the idea of models. . . . Students cannot be expected to become adept in the use of conceptual models, however, until they get to know quite a bit about materials, things, and processes in the accessible world around them through direct, hands-on experience. (p. 267)

It is through active, engaging experiences that students gain access to objects, often referred to in science as hands-on experiences. Students also benefit through such experiences by having opportunities to sharpen their skills of language and thought. It is through many such experiences they begin to see the unseen, visualize the invisible, gain access to a sense of seeing, doing, and being that takes place in their mind. The external experiences, give rise to the strengthening ability to visualize the unseen. When Helen Keller first acquired the ability to understand language, her hunger for learning became insatiable. Given opportunities to experience the world

around them, students in the inquiry-based science class demonstrate such a hunger as well.

Comparing and/or Contrasting

Mankind likes to think in terms of extreme opposites. It is given to formulating its beliefs in terms of Either-Ors, between which it recognizes no intermediate possibilities. (Dewey, 1938/1997, p. 17)

When we think in terms of comparing, what comes to one's mind is often the stark differences between objects or persons or those things which set one apart from the other. But, the origin of the word *compare* comes from the Latin *comparāre* meaning "pair or match" (Onions, 1966, p. 196) and is related to the root *par*, meaning like or equal. Etymologically, *par* is associated with *peer*, meaning "pair or one's equal" (Onions, 1966, p. 662). To compare, then, is to match or to look for similarities, or to consider how things are alike.

To my surprise, numerous discussions about the inquiry-based classroom experience led to comments about the differences conversants observed with their experiences during the remainder of their school day. During one of our conversations, Drew comments:

...in social studies and math you just use your head and write stuff on paper, but in science you get to do stuff and experience it and like learn new things that you might not know and like where you live on earth. (Conversation 1, March 29, 2010)

Roy later adds, "I like to learn hands-on because it's not just reading out of a book and just finding information out of a book, you get to experiment how you can visualize it, how it turns and how it moves" (Conversation 1, March 29, 2010). Both Drew and Roy contrast school activities experienced during reading, writing, social studies, and math with activities reportedly exclusive to their experience in the

science classrooms. It should also not go unnoticed that Drew uses the phrase, “*get to do stuff.*” Opportunities for “doing” are seen as a privilege, not a requirement. There is some small irony in the fact that the primary curriculum resource used during the “space” unit of instruction is entitled, *Experience Science*. The teacher guide states, “The goal of inquiry-based teaching in the classroom is to connect students in a direct way with the *activity* of science” (*Experience Science: Space Teachers Guide*, 2007, p. x).

In a broader sense, it only stands to reason that the goal of any teaching in the elementary classroom should be to connect students in a direct way with the activity of learning. The students’ school experiences should be connected throughout the day, with notable differences being the exception, and a comparison of similar kinds of experiences the norm. This is not the case for this group of conversants.

In another example, Cherry describes a lesson with Mrs. Z experienced in the inquiry-based classroom during which she and the class work with mini solar panels and light sources. She is contrasting a typical writing assignment during another part of her school experience with a writing activity during a science lesson. Cherry and I have the following conversation:

- Cherry: It can help when you have the object to help you learn and everything, instead of just writing about it. And sometimes our teacher, so she can help us, she gets the thing that we’re talking about so instead of just writing it, we can visualize it in our mind and then she gives us the worksheet to do and we can look at it and everything.
- Mr. Horne: Would you call that hands-on?
- Cherry: Yeah.
- Mr. Horne: Or is it something you don’t touch, just something you see?

Cherry: Well something like that you see, but she lets us touch it too. (Conversation 1, March 29, 2010).

Here we see a reference to the perceived benefit, expressed by Cherry, when given the opportunity to engage in a school activity facilitated with a thoughtful teacher who provides access to multiple modalities. Cherry states, "...she lets us touch it too." This type of enthusiastic response is seen over and over in the space science classroom and such comments are repeatedly reflected in the conversants' dialogue.

In *Eternal Echoes*, O'Donohue (1999) gives greater understanding:

"Childhood is an absolute treasure house of imagination. It is the forest of first encounters to which we can never again return. We have become too used to the world; wonder no longer animates us as it did then" (p. 33). That which I find so easy to take for granted, such as the exploration of a solar panel, Cherry sees as a gift – a new and exciting opportunity. Mrs. Z provides that gift in a simple and thoughtful act. During a comparison of science with the other school subjects, one should expect to find similar animated stories of engagement, motion, seeing and doing throughout their experience. Such stories do not emerge. Is it possible that there is a paucity of such experiences in the children's lived experience in school?

During another conversation, Jacquelyn contrasts the inquiry-based science experience with other parts of the day. She states:

Yeah, you really do experiments like, like you know how we have, like, science fair and stuff? We do have experiments. And math class, and language arts, and all that, they, we don't really do experiments; you have to like write essays. (Jacquelyn, Conversation 6, April 8, 2010)

The phrase, "have to" stands in contrast to Roy's "get to" and Cherry's "lets us." The conversants are painting a picture of the inquiry-based space science classroom that is

active, enjoyable, and desirable. It is a place they *want* to experience. As Dewey earlier reminds us, the experiences are not only immediately enjoyable, they also lead to "...experiences that live fruitfully and creatively in subsequent experiences" (Dewey, 1938/1997, p. 28). In many ways the students are experiencing space, but in what other way is space experienced?

Moving

Being free has several levels of meaning. Fundamental is the ability to transcend the present condition, and this transcendence is most simply manifest as the elementary power to move. In the act of moving, space and its attributes are directly experienced. (Tuan, 1977, p. 52)

As conversants describe the inquiry-based science classroom, they frequently make references to opportunities to engage bodily in the inquiry-based classroom experience. Jacquelyn comments on the space science classroom, "... you actually get up and move around. And otherwise, in math, you stay in your seat like the whole time" (Conversation 6, April 8, 2010). Cherry elaborates, "Yeah, and like in science, we get to move up [and] around and like talk in like these groups and everything. In math, we just sit and do individual stuff" (Conversation 6, April 8, 2010). Ella adds, "I just think what's fun about science is like you get to move around. And you get to learn all these different facts that you probably didn't know" (Conversation 6, April 8, 2010). Try to imagine Jacquelyn, Cherry, or Ella in the classroom. What do they look like? What are they doing? How are they experiencing movement? Lingis (2007) gives us language to help capture the bodily sense of the experience:

Our body's stance at any moment is not simply the resultant of the position of the parts, each determined by the force of gravity and the outside pressures and internal tensions; there is an internal diagram that orients our body toward its task or objective and positions its limbs and sensory surfaces...Making our way through a crowd or

through the narrow turns of a cave, we sense the volume our body is occupying. This awareness is not the result of observation; it is produced by taking up positions and enacting movements. (p. 47)

The students are in motion, purposefully pursuing particular positions, smiling, subtly bumping, experiencing touch, processing dialogue, filtering noise. They recall the activity as fun and as a chance to get to move. But what is it like for them? How do such opportunities impact their learning experiences? How can we gain any further insight?

The following dialogue occurs during a conversation about using sun, earth, and moon models to act out their motion in the sky.

- Drew: It's easier to see it and not read it out of a book because in a book you read something and you might not get it, like know what you're reading. But when you see it in person you know what you're doing because you're seeing it.
- Jacquelyn: ...if you read it in a book and you don't know what it is, but if you visualize it, you can ask questions like why does it do that? (Conversation 1, March 29, 2010)

Drew and Jacquelyn's comments reveal more about the positive experience of moving and acting out phenomenon than they do about the limitations of reading. In *Science for All Americans* (1990), Rutherford and Ahlgren make a claim that "Young people can learn most readily about things that are tangible and directly accessible to their senses – visual, auditory, tactile, and kinesthetic" (p. 186). The language here suggests a match between the students' comments made during conversations and the description offered by Rutherford and Ahlgren. They appreciate the opportunity to engage their senses and recognize the positive impact it has on their learning experience. Casey (2000) reinforces the power of learning through the body:

...the body is of centralmost concern in any adequate assessment of the range of remembering's powers. For this reason, we cannot afford to neglect it any longer. If the body is indeed "the natural subject of perception" and "the point of view on points of view," body memory is in turn the natural center of any sensitive account of remembering. (pp. 147-148)

The body is obviously a natural conduit through which to experience the world, and therefore a powerful aspect of our ability to learn. But, do not make the assumption that I am critiquing the value of reading in the elementary classroom, or during science instruction. Nor am I making a charge against alternative instructional techniques in the elementary math or language arts classrooms. By no means! The *Standards* make it clear that hands-on activities alone are not descriptive of the inquiry-based science classroom, while reading is not an activity banished from inclusion in the inquiry experience. The *Standards* document states:

Although the Standards emphasize inquiry, this should not be interpreted as recommending a single approach to science teaching. Teachers should use different strategies to develop knowledge, understandings, and abilities described in the content standards. Conducting hands-on science activities does not guarantee inquiry, nor is reading about science incompatible with inquiry. (National Research Council, 1996, p. 23)

A fundamental purpose of phenomenological research is to look for common threads in the data in order to identify themes. Van Manen (2000) states, "In determining the universal or essential quality of a theme, our concern is to discover aspects or qualities that make a phenomenon what it is and without which the phenomenon could not be what it is" (p 107). The question to confront from a student's point of view is: Without *activity* (hands-on, experiments, touching, moving, doing, visualizing), would the inquiry-based classroom experience be "what it is?" Further conversations support the premise that a picture of physically and

mentally *active* students in the space science classroom gives a window into an essential quality of the experience. Here is another example:

- Jacob: I think a couple of stuff is confusing like how do the planets rotate and revolve. And I think it's fun when you do the experiments with the light bulb and the Styrofoam.
- Mr. Horne: Why is that fun?
- Jacob: Well because you can experience how space works and how they rotate.
- Mr. Horne: Wouldn't you rather just read about that?
- Jacob: No, because I learn more by doing than reading or seeing, and I just think this is cool.
- Sean: ... I like to read about stuff I didn't learn and sometimes I don't because I already knew that, and I think that it's fun doing it instead of reading it.
- Mr. Horne: Like, for example, something we did in space science?
- Sean: Like we did summer, winter, fall, and stuff and we had the Styrofoam balls and we kept on putting them, seeing how we could see them, seeing what the moon looks like at night, and I kind of liked learning about "the man on the moon" and stuff. (Conversation 3, March 30, 2010)

During our conversation I ask Jacob why the hands-on experience is fun. I want to understand the meaning of fun in the space science classroom. He offers a brief explanation and is followed by Sean, who adds further detail. Later, as I read the transcript of our conversation, I remember the described experience of the events that took place in the classroom months earlier. Suddenly, their comments take on deeper meaning. Literally and metaphorically, the light bulb goes on!

Engaging

Learning is a matter of engagement: it depends on opportunities to contribute actively to the practices of communities that we value and that value us, to integrate their enterprises into our understanding of the world, and to make creative use of their respective repertoires. (Wenger, 1998, p. 227)

Imagine a room with a bare 100 watt lightbulb in the center, mounted with a clamp to the audio-visual cart. The overhead lights are out. The students are standing, positioned in a circle around the perimeter of the room. I am directing them to *think* and *act* by giving directions and asking questions. At this point I am reminded of a quote from Jardine, Clifford, and Friesen (2003), “Children like to work hard – if that work is meaningful, engaging, and powerful” (p. 103). The authors call this “hard fun.” This premise motivates me to action. I say, “Let’s act out a year! What do we do now?” A few hands go up. One student suggests walking in a circle around the lightbulb. I ask, “Okay, which way?” Many responses are offered, mostly in unison: “Counterclockwise, for crying out loud (a phrase we enjoy using to add emphasis – and fun)!” With that, we all start to move, counterclockwise, earth models in hand. I pose another question, “How do we know when a year is up?” Suggestions spontaneously follow – no hands are raised this time. Next I say, “Well, let’s act it out—” In unison the students complete the sentence, adding “—for crying out loud!” Wenger (1998) supplies insight into this lived moment of time unfolding in the classroom:

Practice does not exist in the abstract. It exists because people are engaged in actions whose meanings they negotiate with one another...Practice resides in a community of people and the relations of mutual engagement by which they can do whatever they do. Membership in a community of practice is therefore a matter of mutual engagement. (p. 73)

The actions of this community of learners are, at once, taking place in space (spatial) and time (temporal), bodily (corporeal) and socially (relational). All aspects of our lifeworld are seen overlapping in the classroom experience.

Later we add a moon model to the lesson and move into the hard work of determining (seeing, visualizing, acting out) what it must look like for the earth to revolve around the sun while the moon revolves around the earth. In whole-group discussion, we interact for awhile, and then students meet in small groups to consider the concept further while planning how to use a model to demonstrate the motion. Eventually we get back together as a whole group, share our thinking, and discuss each others' ideas. All the while, the students ask questions as I answer or pose counter-questions. It is a web of interaction, including thinking, acting, moving, discussing, modeling, answering, and asking.

Before even half of my lesson plan has been completed, the clock tells us it is lunchtime. As any experienced teacher knows, this kind of interruption is to be expected. Tomorrow we will pick up where we left off. Freire says, "Teaching, which is really inseparable from learning, is of its very nature a joyful experience" (1998, p. 125). This is precisely what we are all experiencing as we head to lunch! During such classroom interactions, the students are learning and they are questioning, while I am continually discovering new ways of engaging learners and responding to questions I have never before been asked. The mood in the room becomes electrifying. I leave knowing that today something special has happened. The students' interests are sparked; there was a sense of wonder, curiosity, and joy. Katrina articulates her analysis of the day this way, "I like moving around and having fun" (Conversation 6, April 8, 2010).

Every day is not experienced like this, of course. We also have times of distraction, confusion, boredom, and worse. Please do not imagine that the active feel

of the inquiry-based classroom equates to a flawless learning environment with eternally euphoric students. Classroom dynamics are messy, fun, and challenging. Every teacher knows these days, these moments, and these difficulties, but we continue to challenge our practices so that, with integrity, we can try to do the next right thing for our students.

The daily rhythm of the classroom has both elements of repetition and uniqueness. Each lesson dictates its own pace, suggests certain materials, and demands varying amounts of time, and effort. Overall, though, the experience in the space science classroom is permeated with a picture of dynamic and active mental, physical, and emotional activity.

Listening

Developing our skills in listening, learning ways to channel our hearing and modify the structures we habitually impose on auditory situations, we can make the world a happier, more beautiful place in which to dwell. (Levin, 1989, p. 89)

The act of listening, described here brilliantly by Levin, is another essential element of a healthy, vibrant, active classroom. During a conversation about the inquiry-based classroom, Jacquelyn and Katrina make insightful comments about the connection between the active classroom and listening:

- Mr. Horne: Okay Jacquelyn, what, what makes science fun?
Jacquelyn: Well, I was going to say, when you move—
Mr. Horne: Mm-hmm.
Jacquelyn: —you move around. Instead of sitting in your seat and listening because some people just zone out. You have to get up and move around, and then you actually listen. And then you, then you actually know what, what's really going on.
Mr. Horne: So tell me, if you can, anybody, about listening. Like in the school day, when you come to school, there are a lot of things to listen to. You come, and your teacher

has all kinds of things to tell. How is the listening different in science than it is in other subjects? Or maybe it's the same. Katrina?

Katrina: It's different because you get to move around, and you get to act how it is, instead of just listening. So you move around. And you might even understand it better when you move, where you act it, instead of just sitting down and listening to the teacher.
(Conversation 6, April 8, 2010)

Jacquelyn and Katrina suggest that listening can take place while active, a both/and scenario, rather than an either/or approach. Listening *and* doing. Listening *while* doing. The negative reference to listening referenced in the transcript is indicative of a typical model of direct instruction seen in classrooms with the teacher speaking and the students silently "listening." Katrina describes it as, "...sitting down and listening to the teacher." Her tone, lost in the transcript, is not particularly complimentary to this instructional format. The conversants' comments show the inquiry-based classroom in a different light than their typical school experience. The active classroom can be a place of doing and also a place of listening.

Remembering

Body memory alludes to memory that is intrinsic to the body, to its own ways of remembering: how we remember in and by and through the body. Memory of the body refers to those manifold manners whereby we remember the body as the accusative object of awareness, whether in reminiscence or recognition, in reminding or recollection, or in still other ways. (Casey, 2000, p. 147)

Casey makes a convincing case for the connection between body movement and memory. Students often make references to activities they remember that involve physical movement and activity. During a conversation near the end of the school-year we began to share memorable moments from our time together. Ella says she remembers, "When we used to like get up and instead of sitting in our seats and just

learning we used to get up and do it, like, how to orbit and rotation.” Sean tries to share a thought when Gregg, a person of few words, interrupts with, “It’s physical.” He is referencing, as so many other students have already articulated, the tactile or kinesthetic nature of the inquiry-based classroom experience. When Sean finally gets the opportunity, he lists a number of things he remembers, concluding with, “Another is when you chased Chad.” I ask why the chasing activity is memorable. He replies, “Because it was just funny.” Everyone laughs at the memory of the lesson, a light moment when Chad and I act out the interactions of the earth and moon. These experiences are linked to bodily experiences. The conversants recall the actions that took place, but also the sense of the experience they felt in their body and the positive emotional response.

The conversation takes a turn when I am asked about my most memorable moment from the inquiry-based space science experience:

Gregg: What was your favorite time, Mr. Horne?
Cherry: Yeah, what was yours? (Conversation 17, June 10, 2010)

Only later, when I have time to reflect on the conversation, do I recognize the ease with which the small group of students included me in this aspect of the conversation. No longer was I the one asking all the questions. I had become part of their community, not an outsider looking in. I was caught off-guard, humbled, and elated. They had opened themselves to each other, and to me, and they allowed me to do the same for them. I respond:

Mr. Horne: That’s a good question... I really like when we do the science talks and everybody gets around and shares some of their ideas. And then we did the stuff with the

light bulbs and the models. I thought that was a lot of fun and you all were really— [*Cherry interjects*]
Cherry: Liked it!
Mr. Horne: —into that!

My unrehearsed response reflects the essence captured in the *active* theme described in this section. I reference the hands-on, "...we did the stuff with the light bulbs and the models." My response also captures the essence of my observation of the disposition of the students in the active inquiry-based classroom: "...you all were really—into that!"

I cannot picture the inquiry-based classroom without visualizing engaged learners knee deep in hands-on, active learning. At the heart of learning is remembering. What, then, does remembering do with us as learners? What impact will the memories formed this year have on the future of these students? How does the active nature of the experience impact the students' memories of the experience and how they experience learning in the future?

Focusing the Light

When one looks into space, it is common to see quite simply, space – a sea of black, seemingly lifeless and uninspired. On the other hand, coffee table books of images from space offer dramatic photos of galaxies, planets, moons, and other exotic celestial objects. Such works give a somewhat distorted view of the universe, but they also beautifully represent an up-close look at what is out there.

In similar fashion, to bring the sub-themes of this section together, I took the reflective voices of the students and distilled them down to create a coffee-table-book-view of the lived experiences of the conversants. In so doing, I hope to bring a more insightful view of their experience in the active inquiry-based classroom.

When It's Fun – It's Fun Because...

You get to do experiments...you get to test things out...

Yeah, you really do experiments...

But when you see it in person, you know what you're doing ...

I think it's fun when you do the experiments...

You passed out these cool balls to pretend like they're moons...

We all got in a circle and you showed us like how to orbit...

I learn more by doing...because you can experience how space works.

You could visualize, you could hold it...

It's easier to see it...

If you visualize it, you can ask questions like why does it do that?

We can look at it...

Because you're seeing it...

We can visualize it in our mind...

She lets us touch it too.

You have to get up and move around, and then you actually listen...

And then you, then you actually know what, what's really going on...

You get to move around, and you get to act how it is...

You might even understand it better when you move...

And I kind of liked learning about "the man on the moon"...

When you get up, you, like you learn more...

And you get to learn different facts that you probably didn't know.

Instead of just the teacher saying it and just sitting down...

You actually get up and move around...

I like moving around and having fun...

What's fun about science is like you get to move around...

Instead of sitting in your seat and listening...

Because some people just zone out...

Yeah, and like in science, we get to move up around.

I just think this is cool!

(Compilation of student comments revealing the *active* theme, 2010)

The active nature of the inquiry-based classroom, like the active nature of the cosmos, reveals a place alive with movement, energy, transition, and change. Yet this is but one aspect of the dynamic process seen in the lived experience of students in the inquiry-based classroom. Next I examine the interactive nature of the cosmos mirrored in the children's inquiry-based experience.

Reflecting the Light: The Interactive Inquiry-based Classroom

Even as the planets reveal themselves across the universe, they retain the emotional weight of their long influence in our lives, and all that they have ever signified in earth's skies. Gods of old, and demons, too, they were once – they still are – the sources of an inspiring light, the wanderers of night, the far horizon of the landscape of home. (Sobel, 2005, pp. 10-11)

The word *planets*, from the Greek *planetes*, means, “wanderers” (Onions, 1966, p. 686). They are called “wanderers” because, to observers long ago, they were stars that did not act like the others, changing position nightly rather than following a more easily predictable pattern of movement as do the stars.

Sobel eloquently and poetically describes the impact of the planets on humanity, at one point noting that planets are “...the sources of inspiring light.” In many senses, this is true. Ancient myth and legend are full of stories of planets as gods. Endless tales of extraterrestrial life refer to our planetary neighbors as home to aliens – little green men from Mars. The fascination with the planets is clearly evident today in elementary schools across the nation. Many students, including each of the twenty conversants in this study, when asked, are quick to tell their favorite planet, and anyone who has spent any time at elementary science fairs (I have been to hundreds over the last twenty years) can testify to having seen more than a few solar system models.

Actually, while it is true that planets are sources of “inspiring light,” as Sobel suggests, they are not sources of their own light. We see them because of light's interaction between the sun and the planet. It is amazing that a distant object, such as Jupiter, is visible in the night sky because light from the sun travels to the planet,

bounces off, and returns back to earth, giving those who glance its way the gift of illumination.

Jupiter, one of the brightest objects in our night sky, is 484 million miles from the sun, evidence of the intense power of our nearby star. When Jupiter and Earth are closest, Jupiter is 391 million miles from Earth. At the point where Jupiter and Earth are most distant from one another, Jupiter is 577 million miles from our home planet. Put the numbers together and imagine a photon of light leaving the sun, hitting Jupiter, and returning to your eyeball here on Earth. That process takes between 72 and 88 minutes depending upon their distance apart at any given time. Remember, light is super fast; therefore, Jupiter must be really far away.

Without the interactive nature of light and the reflective nature of the planets, their beauty and color would be invisible to us. As O'Donohue (2004) informs us:

It is the light rays which the object resists and will not let in that return and reach our eyes. The very thereness of a flower or a stone is an act of resistance to light, and colour is the fruit of this resistance. The colours we cannot see are the ones the object absorbs. The colour it rejects is, ironically, the one in which we see it dressed. (pp. 87-88)

Jupiter's striped bands of orange hues, Venus' yellow din, and Mars' rusty red surface are visible to us because of the intensity of our sun and the reflective qualities of their surfaces, bouncing back their unique features and colors. To *reflect* is defined as, "to bend or throw back light" (*Webster's New World Dictionary*, 2001, p. 1204). The term is used in science to describe properties of light, but also has metaphorical implications.

For example, the term *reflect* also means, "to think seriously; contemplate (on or upon); to recollect or realize after thought (that)" (*Webster's New World*

Dictionary, 2001, p. 1204). The word comes from the Latin *reflectere*. Its root, *flectere*, is to bend (Onions, 1966, p. 750). *Bend* means “to turn or be turned from a straight line or from some direction or position” (p. 134). The early meanings of *reflect* and its root, meaning to *bend* casts a better understanding of our common use of the term in educational circles. Teachers, for example, who “reflect” on their practices, take time to think seriously about their instruction, often resulting in a bending or turning from a particular way of being or doing to another – a change of course or direction. On the other hand, one who is not reflective will continue to move in a particular direction, acting just as light, moving in a fixed trajectory without deviation.

Conversely, from a scientific standpoint, *absorb* means “to suck up; take in and not reflect.” But absorb also can mean, “to take in and incorporate; assimilate” (*Webster’s New World Dictionary*, 2001, p. 5). When we think of absorbing information, we take it in, “like a sponge” without any change – it is assimilated, but without reflection.

Of all the objects in the universe, perhaps the most extreme example of absorption is the black hole, defined as “a celestial object or dark region in space, perhaps formed by the collapse of a large star, with such a great mass that its gravitational field will not let even light escape” (*Webster’s New World Dictionary*, 2001, p. 151). By way of analogy, imagine the members of a classroom community, like a black hole, with no ability to reflect light of any kind. They would be un-giving, silent, absorbing, and unable to return anything. Even in the presence of a

massive source of light, they would show no discernable response. Like a black hole, they would only take in, but never give back.

Barnes (1992) helps to illuminate the contrasting metaphors:

Learning can be a passive acceptance of the beliefs and practices of the people about us; in our culture however we have learnt to value reflexive thought, the knowledge which we ourselves can shape and reapply. Reflexive learning seems to occur when a learner, acting upon purposes which are significant in his life world, is faced with disjunction between his implicit beliefs and those of the persons he is interacting with. (p. 106)

The inquiry-based classroom can be a place where learners move beyond passive acceptance, and beyond absorption. It can be a place where students begin to reflect, learn to interact, and can experience opportunities that challenge their current beliefs.

Participants in the inquiry-based classroom, both teacher and students, like the planets in our solar system, are each unique wanderers, active, interactive, and reflective. They mirror varying amounts and frequencies of visible light, distinguishing their individuality with varying shades of color and beauty. They are each part of an interrelated system, traveling together through a particular space. While reflective, they, too, are sources of an inspiring light; they can absorb; but more importantly, because they are interactive, they reflect. Like light, they are quick, mysterious, colorful, bright, glowing, and essential. Their experience in the inquiry classroom is reflective of their need for space and desire to be active and interactive.

Communicating in the Interactive Classroom

In comparison with many other social settings, classrooms are perhaps among the most crowded human communication environments. Here young people are involved in discussing, debating, arguing, talking, and chatting as well as nonverbal interactions. Few adults spend as many hours per day communicating in such crowded conditions. (van Manen, 2002, p. 89)

Breaking down the word *interactive* to its component parts, the prefix *inter-* has various meanings including, “between, among, in the midst of, mutually, together, or during.” The root word, *active*, means “engaged in action, characterized by energetic work, participation, etc.” (*Webster’s unabridged encyclopedic dictionary of the English language*, 2001, p. 20). Together they form, *interactive*, meaning “acting one upon or with the other” or “interacting with a human user, often in a conversational way” (*Webster’s unabridged encyclopedic dictionary of the English language*, 2001, p. 992). The language found in the definitions help to express lived meaning as experienced in the inquiry-based classroom. Words like *engaged*, *energetic work*, *participation*, *with*, *interacting*, and *conversational* suggest a dynamic human interplay.

The inquiry-based classroom, as seen through the light of the eyes of the conversants, is a physically active place of learning, kinesthetically engaging, a learning-in-motion, but it can also be seen as an interactive endeavor. The students are involved together, as van Manen (2002) describes in the quote above, “...discussing, debating, arguing, talking, and chatting as well as nonverbal interactions” (p. 89). But there is more to an interactive experience than merely creating opportunities to work in groups. Barnes (1992) gives clarity:

I certainly do not wish to give the impression that all a teacher has to do is to put his pupils in groups and leave them to learn. With many classes, useful group work only becomes possible when successful class discussions have reassured pupils that their contributions are valuable, both from the teachers’ point of view and their own. (p. 130)

Navigating the complexities of an interactive classroom experience that also provides relevance is not an easy charge. Interactions must be relevant and

meaningful to have impact on student learning. But, are such interactions an essential part of the inquiry-based classroom experience? Van Manen's concept of imaginatively deleting a potential theme from a phenomenon so one can consider whether the phenomenon loses its fundamental meaning can be a very effective approach here (see also pp. 160-161). Imagine the inquiry-based space science class without student-to-student and student-teacher-student interactivity, a classroom void of verbal and even non-verbal interaction between participants. Perhaps it would look like a party, alive with movement, dancing, eating, music, games, but void of words. The classroom might be filled with students engaging in hands-on activities, up from their seats, laughing, touching, seeing, and doing, but all the time acting independently of one another. Is this a picture of the inquiry-based classroom as the conversants experienced it? Is something critical missing here?

The *Standards* prompt us to consider a view of the inquiry-based classroom with the presence of children's interactive dialogue. They state:

The *Standards* call for more than "science as a process," in which students learn such skills as observing, inferring, and experimenting. Inquiry is central to science learning. When engaging in inquiry, students describe objects and events, ask questions, construct explanations, test those explanations against current scientific knowledge, and communicate their ideas to others. (National Research Council, 1996, p. 2)

The inquiry-based classroom described here is rich with language. Students are describing, asking, explaining, and communicating. They are doing, but they are also speaking. While this image of a science class aligns with the conversants' descriptions of their inquiry-based science classroom, it does not reflect how they

initially responded to the inquiry-based environment. As we came to discover, learning to do inquiry takes time.

Learning to Interact

In learning science, students need...time for asking around, reading, and arguing; time for wrestling with unfamiliar and counterintuitive ideas and for coming to see the advantage of thinking in a different way. (Rutherford & Ahlgren, 1990, p. 193)

After reflecting on the events of the school-year, one particular day early in our experience stands out as an important milestone, indicating a critical moment in our journey through inquiry-based science. It took place on a chilly morning in early February, just a few days into the space science unit. Mrs. Z had agreed to spend the first few weeks observing, while I did a majority of the teaching. After an introductory period of discussion followed by a hands-on lesson, I instruct the class to start moving desks and rearranging them so that we could configure the room, as best as possible, in a comfortable circular seating arrangement, such that all students could see one another. We are about to try our first Science Talk (Gallas, 1995). The mood of the class shifts in a noticeable and surprising way. I realize that this is not something Mrs. Z had tried before. Students wonder aloud about what we are doing and why we need to rearrange. “Are we in trouble? Did we do something wrong? What’s going on?”

Having done this type of activity so many times before, it did not occur to me that I was asking them to do something so far from the ordinary, for them. Mrs. Z maintains her composure, but she, too, seems to be concerned by my directions. Up to this point she has been relaxed and comfortable serving in a spectator role, taking advantage of the opportunity to observe the interactions of her students with each

other and with me. As we begin the process of moving desks, pushing furniture aside, and reorganizing the room, she stands up, moves in close, and works to assist and direct the transformation. The room is cramped, so the regrouping of students, desks, and chairs takes a few minutes to complete, and even after the initial shuffle, there are still a number of students who are not ideally positioned for a whole-group discussion.

Eventually the students settle into their spots in a circle-like formation. I comment that we should be able to regroup into a circle more quickly next time, now that we have done it once. The discussion is, at first, awkward. The question, “Why does it get dark at night?” leads the participants to share their ideas. As some students struggle, I offer the use of an earth model as a visual aid for their explanations. As the conversation progresses, students take turns sharing statements of fact related to the question. For example, one student states, “I think it gets dark at night because of the sun.” Through prompting and coaching, I begin to model for the students how to follow-up with questions if they do not understand their classmates’ comments and to challenge their fellow students’ statements politely if they disagree with information shared. I prompt, “It is okay to ask, ‘What do you mean?’ if you don’t understand someone’s answer.”

While I recognize the initial level of discomfort caused by the activity, I do not realize the degree of impact it has. Through subsequent conversations, I would better grasp the shift that began through the simple activity. I learn that neither the students nor the teacher had previously experienced many meaningful total-group interactive discussions.

A few months later, during a small group conversation after the conclusion of our study of space, I ask, "...we have Science Talks, you know, where you sit in a circle or we have small group discussions. Don't you do that in other subjects?"

Several students respond in rapid succession:

Drew: Nope.
Ethan: No.
Sean: Not always. (Conversation 7, April 15, 2010)

Sean's "Not always" is more accurately interpreted as, "Not ever!" In a written reflection, Georgia later writes, "I like an inquiry class because you can ask about what you don't understand like maybe why it gets dark at night. I learn more in an inquiry class. It helps me more." But, how does it help Georgia?

What I imagine as a first step in a series of carefully planned interactions designed to lay the groundwork for meaningful learning in the inquiry-based classroom, turns out to be a dramatic shift in thinking and being for the students and, even more so, for Mrs. Z. I had taken for granted that children in the elementary classroom would be familiar with and comfortable engaging in total group discussions. I had just taken, without being aware, the first steps toward building an interactive experience for the class – a practice that, over time, would eventually give these children new opportunities to experience space. But, as van Manen (2003) says "...lived space is more difficult to put into words since the experience of lived space (as lived time, body) is largely pre-verbal; we do not ordinarily reflect on it. And yet we know that the space in which we find ourselves affects the way we feel" (p. 102). Through reflection, writing, and conversation, the students, as well as Mrs. Z,

continue to provide insight into the lived experience in the inquiry-based classroom and the nature of the space it provides.

Reflection Leads to Revelation

If we think of what goes on in schools solely in terms of conformity to norms, we omit the school's manifest purpose, the pupils' participation in the enactment of knowledge. When we look at the communication system of a school or classroom we can ask: What part do the learners play in the formulation of knowledge? (Barnes, 1992, p. 18)

Without opportunities to reflect, questions such as the one posed by Barnes in the quote above, quite often go unanswered. What part, then, do learners play in the formulation of their own knowledge? How and when is such knowledge acquired?

At the end of the school-year, Mrs. Z and I had an opportunity to reflect on the past months' events, sharing stories and recalling significant moments. Looking back, I could not forget the dramatic response I sensed at the start of the unit, when I first put the students eye-to-eye with one another. During our conversation I ask Mrs. Z about her evaluation of our Science Talks. She replies:

I really enjoyed the Science Talk because, you know, when we first did the Science Talk the first time at the beginning of the space unit, I was... taken back because, you know, my desks were being pushed away, my children were coming together to form a circle, and I hadn't seen that done before. And I was, like, "Oh my goodness. Are my children going to be able to handle this?" But they were actually really able to kind of catch up to speed and able to get themselves together and I was able to join the group and sit back and listen to some of their thoughts at this talk, because they were face-to-face. We were all face-to-face, as opposed to, in a traditional classroom set-up... And it was interesting, as the teacher, to just sit back and watch and listen, as opposed to being the one who's always doing the talking... You know, just being able to move the desks and have my children form some sort of circle that we can all look at each other and have more of a conversation, than more of like a lecture.
(Conversation with Mrs. Z, June 8, 2010)

Mrs. Z was “taken back” because her desks were being moved. She states, “...my children were coming together to form a circle, and I hadn’t seen that done before.” More than a gut reaction to something new, her response reveals a transformation. She catches a vision of students interacting in a productive way that could lead to the formulation of their own knowledge. She embraces the idea as her own. According to her comments, the students, like her, are unsure at first, but quickly adapt. This is the nature of the learner in the inquiry-based science class. At the heart of the experience, children want to interact. They long to share their questions and their thinking. While they do not always know how to do this, it can be modeled for them. Gallas (1995) writes:

Saying what you think about a question on which you are not an expert is extremely risky. To be fully engaged, the student must trust that the ideas put forth will not be treated pejoratively and will be worked with as part of the classroom dialogue. (p. 44)

Mrs. Z had already developed a foundation for success. While her students were unfamiliar with the format and ground rules for interactive dialogue, they had grown to trust her and trust one another. This significant development of relationship allowed for rapid success while using a different way of communicating from the format with which the children were familiar. Van Manen (2003) expands on this point:

The teacher-child relation is experienced as a special lived relation to the other in the sense that this relation is highly personal and charged with interpersonal significance...And in this lived relation the child experiences the adult’s confidence and trust without which it is difficult to make something of oneself. (p. 106)

These truths cannot be overstated as we examine the interactive nature of the inquiry-based classroom. Van Manen uses the term, *interpersonal*, meaning “between

persons” (*Webster’s New World Dictionary*, 2001, p. 746). We see that lived relations are essentially interactive. The term interactive is defined as, “acting one upon or with the other” or “interacting with a human user, often in a conversational way” (*Webster’s Unabridged Encyclopedic Dictionary of the English Language*, 2001, p. 992). The lived language suggests dynamic and meaningful interrelations alive with action and conversation.

Later in our conversation, Mrs. Z acknowledges the impact of her efforts to develop a sense of community in the classroom. She comments:

I think a lot of it stems to what kind of rapport you have with your students. Did you set up those expectations early on? Did you develop some sort of community early on where the students are going to feel comfortable sharing in that kind of setting? ...So I would think that it all stems back to the beginning of the school year and how, throughout, you are working with those students. (Conversation with Mrs. Z, June 8, 2010)

Mrs. Z recognizes the essential nature of relationship in the elementary classroom.

Applebee (1996) reinforces Mrs. Z’s comments, stating:

If students are to learn to enter into culturally significant schooled traditions of knowing and doing, they will do so through their participation in the language and culture of the classroom. (p. 35)

Mrs. Z takes responsibility, from the first day of school, to establish and maintain a positive classroom culture. Her efforts serve to benefit the students when introduced to a more interactive, student-centered format for classroom dialogue.

During the following school-year, I visit Mrs. Z to catch up on how she and her students are progressing and how, if at all, her involvement in this study from the previous year is impacting her students now. She is open and excited to share her latest experiences. At one point in the conversation, we start talking about student

interaction and the obstacles associated with implementing such practices in the elementary classroom. The following dialogue takes place:

Mr. Horne: This has been my observation, that it's hard for 4th graders to do that [*have Science Talks*] at first. And I believe that's because of just lack of experience doing it. I imagine that if they'd come in here and they'd been doing those kinds of conversations for, throughout their school career, it wouldn't be any big deal. I think it requires some effort on the teacher's part to teach them how to have a conversation, how to respond to somebody's thinking. Not just say what you think, but listen to someone else. So I think it starts hard, but I think that they adapt to it easily and find it— [*Mrs. Z interjects*]

Mrs. Z: I think it's almost harder for the teacher, too. I mean it's hard for the students, but it's also hard for the teacher to be okay with feeling like you are teaching something a little differently, making a different kind of impact upon the learning, and just stepping outside of their own comfort level as a teacher, and being able to sit back and let conversation drive the discussion. So I would agree with you. (Conversation with Mrs. Z, January 31, 2011)

Mrs. Z's comments are insightful as she speaks from personal experience. She has encountered, first hand, the conflict and elation experienced when opening the classroom to conversation. Barnes (1992) adds understanding based on experience:

I do not believe that we can hurry on the time when the learner is able to explain how a syphon [sic] works by excluding from discussion his earlier and more primitive conception for pressure. Quite the reverse, since it is this conception that needs to be modified. Nor (I believe) do we help the learner by emphasizing his ignorance and dependence on the teacher's expert knowledge. For these reasons the over-control of knowledge by teachers must in the long run hinder learning, whatever social functions it performs then and there in the classroom. (p. 128)

Mrs. Z experiences first-hand the struggle for control, as described by Barnes, and talks about it candidly. She states:

At first it was very difficult because I immediately wanted to jump in, steer the conversation or point them in the right direction or ask my own question. So it was hard to just sit back and really let the children take hold of the conversations and discussions and questions that were being asked. But now it's really interesting to sit back and listen to where their heads are, where their thoughts are. So it's being able to look at it a little differently as a teacher. It's hard too. So it comes with practice and comfort and being okay with stepping outside of your comfort zone. (Conversation with Mrs. Z, January 31, 2011)

It is interesting that the “comfort zone” Mrs. Z references is found in the silence of her students. Why might this be true? She later reveals some insight: “I don't know what kind of questions they are going to come up with and whether or not I'm going to be able to answer them. It is very difficult in that sense, to feel comfortable to allow them to ask whatever they want because, am I going to be able to answer their questions?” (Conversation with Mrs. Z, January 31, 2011). Opening the floor to student comments and questions can create an atmosphere of vulnerability for the teacher. It seems much safer to stay closely focused on dictating information from the content standards, than to allow children the freedom to interact with one another and with the teacher.

Taking a closer look, the word *vulnerable* means “open to attack.” It derives from the Latin *vulnerere*, meaning “wound” (Onions, 1966, p. 987). To be vulnerable, then, is to be easily able to be wounded or easy to attack. The meaning suggests interaction with an enemy or adversary, but certainly not a member of one's community. One would not likely feel vulnerable when they are with others with whom they work with in a caring way. Why, then, would a teacher develop a sense of vulnerability while in a setting where trust and care has been developed? Barnes

(1992) shares a possible rationale for teachers' inclination to suppress conversation in the classroom. He states:

A teacher will be more likely to be constrained in his turn whenever his own grasp of the subject-matter is relatively external, whenever he too is in a state of dependency upon textbook and 'expert.' (p. 127)

Too often such control takes place. Lack of knowledge can create fear, even when meaningful relationships have been established. Even so, with little more than an opportunity to observe the practice of interactive conversations, Mrs. Z has taken the risk, revealing her lack of explicit answers. She has willingly moved beyond her comfort zone, embraced the unknown, and made interactive dialogue a part of her practice in the new school-year, even while acknowledging the difficulty of making such a shift. For those who do not take such risks, choosing to stay within their comfort zone, Gallas (1995) articulates another potential outcome:

If teachers are constantly interrupting children's conversations about the world, then the children eventually will not have those conversations in the teacher's presence. They will believe that their ideas are always being judged and are, most probably, not the right ideas. When they are asked questions, they will search their teacher's face for the right answer, modifying their response at even the slightest nonverbal reaction. The answers they do provide will be the teacher's or the textbooks answer, rather than their own. (p. 100)

Both Barnes and Gallas provide a window into the heart of a student experiencing a disconnect between the passion and excitement of an interactive learning environment and a less engaging experience too often encountered in school. How do the student conversants articulate the interactive nature of their classroom experience?

Beyond Right Answers

What they got was the feeling of a generative rush of insight, the rush of opening. Their gasp (and ours) was caused by a sense of vertigo caught in Alex's excitement. The space he opened for us all was larger

than just his particular questions. It was as if we had come with him over a rise and that just these few particular steps, taken seriously and followed, had opened up a huge horizon of possibilities around all of us. And it was not simply that we now had new territories to traverse. We also now came to understand territories already traversed in a new way. (Jardine, Clifford, & Friesen, p. 122)

The focus of the study is to get to the heart of the experience of children in the inquiry-based space science classroom. In the quote above from Jardine, Clifford, and Friesen, we are given a taste of the excitement that comes through interactive learning experiences in the classroom.

In contrast to a highly interactive experience, emphasis on right answers in the classroom can produce a silencing effect, and has become a repeated source of conversation among the conversants. The following snippet from a conversation captures Roy and Ethan's remarks about right and wrong answers in the inquiry-based classroom:

- Roy: Science is like different from other subjects, I think personally, because there's not, sometimes there's not necessarily a right answer. Some questions will like, you don't really ever will know. And like in math there's always a right answer and wrong answer, and you always have to get the right answer.
- Ethan: ... And just like Roy said, there's not always the right, there's not always the right answer to every solution.
(Conversation 7, April 15, 2010)

Many would argue that the math classroom is more conducive to right and wrong answers. Others would point out that right answers are not inherently bad, even in a science class. Of course not! This line of reasoning, often shared in such exchanges, entirely misses the point. Roy and Ethan have made an unprompted observation about the nature of the inquiry-based experience. They are not condemning their math

teacher's practices. More to the point, they are reflecting on their experiences and commenting on their opinions. Newton (2001) expands on this idea:

A non-judgmental context is intended to encourage children to express their understandings openly. If they know that they can say something that turns out to be "wrong" and not be marked down for it, they are more likely to talk about what they believe to be the case rather than what they think you believe to be the case. A formal setting, with the teacher standing over and dominating the class, firing a barrage of questions at them, is unlikely to give the children this kind of security. You may prefer a less formal arrangement in which the children and you sit as a group. (p. 118)

The ideas in Newton's statement, along with Roy and Ethan's comments, are confirming that the classroom experience does not have to be a teacher controlled forum, with the search for "right answers" as the primary objective. Students in math class or any subject will have a different learning experience when provided the opportunity to think, ask, share ideas, and listen to others rather than to simply take-in information and attempt to provide correct answers to teachers' questions. Applebee (1996) adds insight:

Optimal experiences are unlikely to be generated by the recitation activities that dominate many classrooms, in which students are quizzed about prior learning. They are more likely to occur in response to... "authentic" questions, which encourage students to go beyond previous learning to explore new territory. (p. 107)

From the student dialogues and reflections, what can we learn about the nature of the inquiry-based classroom? How do students respond to classroom experiences that take them into "new territory?" Are students experiencing dialogue as an essential aspect of the inquiry-based experience? Would the inquiry experience be significantly altered without such interactions? I continue to explore the lived meaning of conversation for a 4th grader.

Bouncing Around Ideas

Understanding what a child offers in a classroom conversation as “their opinion” might be intended well, but it is also understandable as a refusing of the gift that is offered by handing it back to them as belonging to them. It is refusing to let it lay claim to us, to address us, to obligate us by its arrival to enter into the movement of thinking it sets forth. (Jardine, et al., 2003, p. 217)

The Samoan Circle activity (also see pp. 82-90) is a platform that allows students an opportunity to address one another, lay claim to one another’s thinking, and offer their ideas as gifts to be received. Ella writes the following comment regarding the Samoan Circle:

It was really fun participating in a Samoan circle! It was really fun because you got to interact like standing up. And, being able to talk!! And we got to be recorded! You got to answer questions and stuff. I love it!! (Ella, June, 2010)

Thankfully I have her original written response; otherwise, some might challenge the authenticity of such a comment. For example, she states, “You got to answer questions...” Her enthusiasm for an intense learning experience is noteworthy. Children in the inquiry-based classroom want and enthusiastically welcome opportunities to reflect on ideas and respond to them – to bounce around ideas of their own. They desire to share their thinking, and their questions with a trusted community of learners.

In a conversation with Cherry and Ella we further discuss the Samoan Circle:

- Cherry: It’s much funner than sitting at our seats and like do it individually, like, you know, and you have a partner and everything.
- Mr. Horne: And why is it fun?
- Cherry: Because you’re, you’re with friends and everything. And like when there are other, when, when you do it individual, it kind of gets boring and everything.
- Ella: And you might even need some help on it.

Cherry: And oh, yeah.
Mr. Horne: Okay, so if you needed help, how does being in a group help?
Ella: Maybe...they'll know things that you don't know. And they might even share their answers and help you.
(Conversation 6, April 8, 2010)

Cherry contrasts individual work with group work. Ella supports Cherry's analysis of group work, identifying several powerful reasons for having an interactive classroom. Paraphrasing, she says, interactive dialogue is fun and it helps because sharing can provide a means to learn things you did not know.

Throughout the unit of study and during our many recorded conversations, students express enthusiasm for opportunities to interact with one another. Gadamer (1960/1989) again illuminates our understanding:

Conversation is a process of coming to an understanding. Thus it belongs to every true conversation that each person opens himself to the other, truly accepts his point of view as valid and transposes himself to the other to such an extent that he understands not the particular individual but what he says. (p. 385)

Acceptance and understanding are powerful motivators to learning. Students in the inquiry-based classroom powerfully experience this. As evidence, children frequently use the word *fun* to describe their experiences in the inquiry-based classroom. Above, Cherry indicates that group work is "funner" than individual work. Unfortunately, fun is too often given a negative association in educational circles. Fun seems to imply easy, fluff, or mindless work. For children, the word seems to take on a more holistic meaning. Fun may indicate that learning is engaging, challenging, stimulating, exciting, worth-while, or any number of other adjectives we might deem appropriate for an educational setting.

I ask the class to respond to the question, “What was it like to participate in the Samoan Circle?” Responses vary, but a clear theme emerges. The following are a sample of responses. The students’ spelling and grammar remain in unedited form (see Appendix C for complete listing):

It was like being in a real science talk, what real scientists do. So it was fun. (Georgia)

Well I like it because we can talk about and discuss about space. Also we can ask questions about space and we can discover about space. Lastly we can have fun. Also we can solve questions about space. (Jacob)

I thought it was fun because it was a four-person group talking and sharing information. Then you would have the audience recording and learning what they said. I liked how you would also hold props to help you. (Drew)

Well it was a place to ask questions and answer them, (also like comments.) I was in the 1st group. We had to answer questions and state comments about the moon and stuff. It was fun, you learn more. (Jacquelyn)

I like that it was a little group. It was awesome to share what we had to say about the faces of the moon. It was even more fun talking to my friends. I liked when we just had to raise are hand and in less than 2 sec. you could share what your, what you thought. (Sean)

It was cool being in a Samoan Circle because you get to ask questions about space and discuse them. (Brunden)

It was cool participating is a samon circle. In a samoan circle you get to share your ideas to others. You can ask questions and people can answer the question you asked. (Ethan)

The first five written responses use the word *fun* to describe the Samoan Circle activity. The final two do not. Instead, they use the term *cool*, which could be considered synonymous with fun. The important thing to note here is what these nine-year-olds are referring to as fun or cool. Serious work and challenging thought

seamlessly overlap their thirst for joy. Dewey recognizes the power of fun and play in the classroom, noting:

The intellectual harm accruing from divorce of work and play, product and process, is evidenced in the proverb, "All work and no play makes Jack a dull boy." That the obverse is true is perhaps sufficiently signalized in the fact that fooling is so near to foolishness. To be playful and serious at the same time is possible, and it defines the ideal mental condition. (Dewey, 1910, p. 218)

The students are engaged and excited about the activity. And at the heart of the activity, we see words and phrases that reveal the interactivity with words such as: share, ask, discuss, and talk. The language of the student comments also demonstrates a focus on discussion of content knowledge. Jacob says, "We can solve questions about space." Drew comments on "sharing information." Georgia says she likes doing "what real scientists do." Brunden notes that "You get to ask questions about space and discuss them." Please keep in mind, these are 4th graders, not AP high school science students. These young conversants are engaged in deep and meaningful content discussions, seeking answers, coming to recognize the power in considering their own questions and the questions of others. Gadamer (1960/1989), commenting on the priority of questioning, provides a thought provoking insight:

[It] consists not in trying to discover the weakness of what is said, but in bringing out its real strength. It is not the art of arguing (which can make a strong case out of a weak one), but the art of thinking (which can strengthen...by referring to the subject matter). (p. 367)

The art of thinking, the cornerstone of learning, is given priority as students have opportunities to interact in meaningful ways. What are these student voices saying to us about the nature and essence of their experiences? How does a reflection

of student voice shed light on the essential? What other aspects of the interactive inquiry-based classroom can reveal a glimpse of that which has been hidden?

Listening, Hearing, and Reflecting

Hearing is intimate, participatory, communicative; we are always affected by what we are given to hear. (Levin, 1989, p. 32)

Children in the study perceive the Samoan Circle activity as fun. Their references, however, tend to reflect only one aspect of the activity. The overall experience is not only intended to provide voice to children on the inside of the circle – those who actively dialogue with one another – it also invites children in the outside circle to listen while quietly reflecting on the dialogue. I ask a group of students to talk about their experience outside the Samoan Circle. The following is a short snippet from a conversation:

- Jacquelyn: I think the inside because, I mean, it's easier because you ask—you answer questions, and you have a lot of people to, you know, back you up. On the outside, you just—you just sit there and listen. You can't really say anything.
- Brenda: ...I think both because when you're listening, you can hear something that you haven't heard before.
- Mr. Horne: Okay.
- Brenda: But when you're on the inside, you can say what you want to say.
- Mr. Horne: ...Who do you think are the best kind of listeners? Do you know anybody in our class that are good listeners or not-so-good listeners?
- Jacquelyn: I think Katrina is. She's quiet, and she knows how to listen.
- Mr. Horne: ...you get the idea that she's listening to you?
- Jacquelyn: Yeah.
- Mr. Horne: And the people who talk too much?
- Jacquelyn: I don't think they would really like listening; and if they're talking, they can't really hear.
(Conversation 14, June 10, 2010)

Jacquelyn comments, “On the outside, you just—you just sit there and listen. You can’t really say anything.” This statement indicates a possible lack of value for the practice of listening. Ironically her comment is followed soon after with a criticism of those who talk too much. She says, “I don’t think they would really like listening; and if they’re talking, they can’t really hear.” Jacquelyn is not alone in this kind of observation. Listening is hard work. Brenda expresses the value of listening, but also comments, “But when you’re on the inside, you can say what you want to say.” Over time, children often embrace the opportunity to share their thinking and they also come to appreciate the power of listening, but this is a skill that must be reinforced with practice and coaching. Levin (1989) states:

Developing our skills in listening, learning ways to channel our hearing and modify the structures we habitually impose on auditory situations, we can make the world a happier, more beautiful place in which to dwell. (p. 89)

The inquiry-based classroom is a place to develop skills in listening and hearing. Elementary students embrace the challenge to listen more carefully and work harder to hear what the other is saying. As educators, we must consider ways to give them this space as they reveal their desire to experience it.

Unfiltered Reflection

Discussion conventions usually operate tacitly, though they are subject to study and change. Much of the current effort at instructional reform has in fact focused on conventions of discussion: Teachers have been urged to ask more open-ended and higher-order questions, to encourage small-group discussions and collaborative activities, and to value students’ questions and tentative formulations rather than concentrating on final products. Such changes in patterns of instruction are designed to shift the emphasis from knowledge-out-of-context toward knowledge-in-action, and thus toward students’ abilities to enter as active participants in the conversational domain. (Applebee, 1996, p. 106)

Applebee acknowledges the education trend toward a more dialogue friendly atmosphere in schools. As educators, we may recognize, intuitively, the motivating nature of working in groups; however, giving space for students to interact without direct oversight, regardless of the value or perceived enjoyment by students, is often reason for concern. Time constraints, concern over standardized test scores, and a lack of understanding about the potential value of such activities are all issues over which educators have had debate. Gallas (1995) prompts us to consider other positive benefits of allowing children to have increased opportunities to experience interactive dialogue with one another. She states:

Children say what they think, revealing naïve and magical theories that they normally would keep to themselves. Thinking out loud, and the degree of trust it implies in the intentions of the group, are critical to raising the voices of less verbal children. In a classroom where there are no opportunities to talk together without teacher monitoring of the talk, children will not reveal these incorrect, but closely held beliefs. Thus, as a teacher, I cannot engage all of my students in the study of science unless a critical level of familiarity and collegial talk is achieved. (p. 44)

A goal of the inquiry-based classroom is for teachers to build a critical level of familiarity with children, so they will develop an ability to share their knowledge and beliefs. The interactive nature of the teacher with students and students with the teacher is a crucial element of the inquiry experience. Applebee (1996) provides additional support for such a practice:

One of the most important features of a pedagogy designed to help students to enter into culturally significant domains for conversation is that it invites genuine participation within the domain, the kind of participation that leads to knowledge-in-action rather than knowledge-out-of-context. (p. 107)

Knowledge-in-action, as Applebee explains, is a knowledge “in context.” The context provides meaning and relevance to the learner providing a motivation for learning. Too often, learning without any context leaves students disengaged. In the space science classroom, time for students to develop an understanding of the content while continually being encouraged to pose their own questions and wonder aloud about their confusions, creates a meaningful atmosphere and appropriate context for learning.

In the following dialogue, Ella and Cherry highlight the collegial nature of their science encounters, suggesting a passion to gather together to encounter one another in a context of knowledge-seeking:

- Ella: ... like in math, and language arts, and social studies, you don't sit like in a circle and tell them like what you know about space and stuff.
- Mr. Horne: What do you do? How is it different?
- Ella: It's different because usually in other classes, you don't, like you don't sit in a circle and share a lot of facts that you know; but in science, you do.
- Mr. Horne: You just don't do that in other subjects?
- Cherry: We just—I'm Cherry—and we just sit at our seats and talk about stuff that we're learning. In science, we have like science talks and like these people where they get in like four, a group of four and discuss. (Conversation 6, April 8, 2010)

I search for the emotion that captures the ideas expressed in the transcript. Somehow the meaning seems to come across flat on the page. But being with these wanderers, these reflectors of brilliant light, and listening to their enthusiastic descriptions of the inquiry-based classroom, their joyful mention of the circles we formed to create a better space to reflect, and their appreciation for time to form small groups to think and dialogue, I can close my eyes and visualize their faces alive with

passion. Capturing their overriding message during our conversations is difficult. I picture a door opening to a darkened room, seeing the light flood in, and observing illuminated faces, marveling with wonder while squinting from the sudden burst of light. I wonder: Where does such zeal come from? How is it maintained? Why are these students so motivated to learn? Applebee (1996), elaborating on the concept of knowledge-in-action, provides greater understanding:

The paradox of knowledge-in-action is that in order to learn something new, one must do what one doesn't yet know how to do. The way out of this paradox is to realize that learning is a social process: We can learn to do new things by doing them with others. (p. 108)

The message the children convey is not, primarily, a story of "I" but much more so, a story of "we." The interactive inquiry-based class is a social experience that necessarily engages them in interactions with one another. Other school experiences that do not provide the same level of interaction stand out to them in stark contrast.

In the next dialogue, several students articulate their level of passion for the interactive experience, contrasting again, what they "have to" do with what they "get to" do. Drew, Roy, and Ethan extrapolate:

Drew: ...Like in language arts you just do like ...
Ethan: It's all from the book.
Drew: You have to write on a piece of paper. It tells you what to do and you do it. But in science it's different.
Roy: It's like— [*Drew interjects*]
Drew: You get in circles and you get to tell each other what you learned and tell each other different stuff about what they learned. (Conversation 7, April 15, 2010)

Later Drew adds, "And it's like different because you're in a group and you talk in situations that are really about science and space and what other people don't know" (Drew, Conversation 7, April 15, 2010).

Drew takes pleasure in the role of teacher. The intense power of wanting to know and the surge of excitement that comes from sharing what others do not know are not mutually exclusive emotions for students and teachers. Children genuinely want to know, and they thrive on the opportunity to share their understandings. Likewise, as a teacher, I never lose my place as a learner, wanting desperately to know and learn, while also relishing the opportunity to share knowledge, to shine light into darkness. I must also be willing to risk exposure of my lack of understanding by admitting when I do not have an answer, or when I am truly puzzled or confused. Noddings (2003) might characterize such exposure as an act of caring. She states:

We act not to achieve for ourselves a commendation but to protect or enhance the welfare of the cared-for. Because we are inclined toward the cared-for, we want to act in a way that will please him. (p. 24)

Is it in the best interest of students in the inquiry-based classroom to see their teacher beyond the persona of the all-knowing depository of information? Is it an act of caring to join with the members of the classroom community as a unique reflector of light, rather than the source of illumination? Freire (1970/2000) articulates a contrasting view of the role that frequently occurs between teacher and student:

Education thus becomes an act of depositing, in which the students are the depositories and the teacher is the depositor. Instead of communicating, the teacher issues communiqués and makes deposits which the students patiently receive, memorize, and repeat. This is the “banking” concept of education, in which the scope of action allowed to the students extends only as far as receiving, filing, and storing the deposits. (p. 72)

Noddings’ description of the caring teacher is far different than Freire’s description of the banking model, depicting the teacher as invulnerable, impersonal,

and closed. The model suggests the teacher as light and students as light absorbers, the opposite end of the spectrum from the picture of students and teacher as reflectors. How does the inquiry-based classroom, as experienced by the conversants, compare with these conflicting models? I continue to listen to the students for clues about their perceptions of the teacher's role.

Mr. Horne: What makes science class something, something memorable or something that's different from language arts or math? You said it was different from math. How is it different?

Brenda: Different because we learned some things.

Mr. Horne: Well, sure, yeah, yeah, absolutely. Do you learn in different ways, or do you use the same kind of ways to learn?

Brenda: Different ways.

Mr. Horne: Okay. And how are they different? Like, what's different?

Brenda: Like when we are in science, we actually get to get in a group. When we were in math, we have to do it—
[*Jacquelyn interjects*]

Jacquelyn: Alone.

Mr. Horne: I see.

Brenda: Yeah, individually.

Mr. Horne: So what's that—well, tell me about that a little bit if you can because that will help me. What's the difference between working alone and working in a group?

Jacquelyn: Well, someone might have a good idea in your group; and if you would, like, you would—if you're an individual, you wouldn't, like maybe you wouldn't think of that. And it's a really good thought.

Brenda: And when you're together in a group, you can get help from someone, from being an individual and having to do it by yourself.

(Conversation with Jacquelyn and Brenda, June 10, 2010)

Here, students justify the value of group-work in the inquiry-based classroom.

A recent article in *Science and Children*, The National Science Teachers Association peer reviewed journal for elementary teachers, reinforces the children's claims.

NSTA has declared 2011 the year of inquiry. February's issue focuses on the topic, "Selecting an Inquiry Experience." In the article, "Inquiry into the Heart of a Comet: Third through Fifth-grade Students Model Science in Action," Cobb, Roundtree-Brown, McFadden, and Warner (2011) describe a process of inquiry that involves students in an action-oriented process, much like that which has taken place in the conversants' space science classroom. The authors describe the path they take to inquiry:

How? By starting with a great hands-on activity, modeling an object in space that introduces both key vocabulary and science concepts with visuals to support retention and learning; encouraging collaboration to enrich student engagement with those concepts as students develop their models; and capping the experience by scaffolding an opportunity for students to engage in scientific argumentation as they discuss the strengths and limitations of their models and brainstorm ways to improve them. (pp. 46-47)

The inquiry-based classroom is intended to be a place of activity and student engagement. Like the classroom described by Cobb, et al., the conversants repeatedly articulate a similar experience, referencing opportunities to experience hands-on activities, student engagement, scientific argumentation, and opportunities to discuss their thinking. Throughout this section, the role and actions of the students are articulated, often using the children's direct quotes. Curiously, in the descriptive vocabulary used by the conversants to describe the inquiry-based classroom, they make many references relative to their activities, but few references to the role of the teacher. Perhaps, the role of the teacher is overlooked because it is assumed or taken for granted. This is to be expected, but what does this say about who or what is the reflective source for illumination?

Reflecting the Light

One aimed for the light of insight, but one ends up facing the darkness of night. (van Manen, 2002, p. 246)

Facing fully into the darkness, the stars shed their meager light from unimaginable distances, reminding us of the grand scope of the universe. Much closer to home, our companion planets, "...the sources of an inspiring light, the wanderers of night, the far horizon of the landscape of home" (Sobel, 2005, pp. 10-11), hide amongst the distant suns, only detectible through detailed observations or clever research into knowledge uncovered over years of study. Our neighboring planets share a common source of light – our sun – visible through the process of reflection.

What has reflection revealed? What light has been observed? If nothing else, we have heard children's voices. Their experiences are being reflected in the pages of text, their stories are beginning to shine through, the essence of their brief encounters in the inquiry-based space science classroom are coming to light. And they emerge as some of the most illuminating sources of light with each other.

Just as at the end of the previous section focused on the *active* theme, I took the voices of children found in this section and condensed them down to create a montage of their lived language. In so doing, I hope to bring a reflective view of their experience in the *interactive* inquiry-based classroom.

But in Science It's Different...

You get in circles and you get to tell each other what you learned.
And tell each other different stuff about what they learned.
In other classes, you don't sit in a circle and share facts that you know...
But in science, you do.

We have like science talks and get in a group of four and discuss.
It's easier because you ask—you answer questions,

And you have a lot of people to, you know, back you up.
You have a partner and everything.

When you're listening, you can hear something you haven't heard before.
When you're on the inside, you can say what you want to say.
She's quiet, and she knows how to listen.
And if they're talking, they can't really hear.

Science is like different from other subjects, I think personally...
Because there's not, sometimes there's not necessarily a right answer.
Some questions will like, you don't really ever will know.
There's not always the right answer to every solution.

It's like different because you're in a group
You talk about science and space and what other people don't know.
And when you're together in a group, you can get help from someone,
They might even share their answers and help you.

Because you're with friends and everything.
When you do it individual, it kind of gets boring...
And you might even need some help on it.
Maybe that, that them, they'll know things that you don't know.

Like when we are in science, we actually get to get in a group.
Well, someone might have a good idea
If you're an individual, you wouldn't, maybe you wouldn't think of that.
And it's a really good thought.

...It's much funner than sitting at our seats and like do it individually.
(Compilation of student comments revealing the *interactive* theme, 2010)

The interactive nature of the inquiry-based classroom, like the interactive nature of light reflecting from the planets in our solar system, reveals a space alive with exchange, reflection, illumination, and beauty. The *interactive* theme, explored here, like the *active* theme explored in the previous section, demonstrate various aspects of the practices seen in the lived experiences of students in the inquiry-based classroom. Next I examine the “inquirative” nature of the cosmos illuminated in the children’s inquiry-based experience.

The Essential Sun: Lighting the “Inquiractive” Inquiry-based Classroom

The Sun rotates on its axis approximately once a month, in a continuation of the spinning motion it was born in. Being an enormous ball of gas, the Sun spins complexly, in layers of various speeds. The core and its immediate surroundings turn at one rate, as a solid body. The overlying zone spins faster, and, above that, the visible photosphere whirls around at several different rates, more quickly at the Sun's equator than near its poles. These combined, contrary motions whip the Sun into a fury, with consequences felt clear across the Solar System. (Sobel, 1995, p. 24)

The enormous sun is the core, or the center, of the Solar System. Its centrality cannot be underestimated. Everything in our Solar System revolves around it, under its control, due to its intense gravitational attraction. When one considers the make-up of our planet, let alone the entire Solar System, it is important to maintain a proper perspective.

The glorious Sun of our time, the planets' progenitor and chief source of energy, embodies 99.9 percent of the mass in the Solar System. Everything else – all the planets with their moons and rings, plus all the asteroids and comets – account for only 0.1 percent. (Sobel, 1995, p. 19)

The sun is not only significant in mass, it is our planet's fundamental source for heat and light. Illumination from the sun is not just pleasant to experience on a spring morning, it is responsible for our very existence. The earth and all the planets are made of material from the sun during the formation of the Solar System. All that we have and know originates with the sun, yet, this massive, life-giving source of energy is largely taken for granted in day-to-day living. A person's thumb at arms length can block the sun from view, making it seem small and insignificant. Its essentiality can be quickly ignored due to its predictable presence. No one imagines they will awake one morning to discover the sun no longer exists.

“Inquiractivity” Introduced

By analogy, the central and overwhelmingly essential source of energy for the inquiry-based classroom can also go unnoticed. Without it, though, the life-giving force, fundamental to all other aspects of the learning process at work in the inquiry-based classroom, is missing. I am referring to the essential nature of questioning. This kind of questioning, essential to the inquiry-based space science classroom, I am calling “inquiractive.” The word *inquiractive* is not found in any dictionary. *Webster’s New World College Dictionary* (2001) defines *inquire* as, “to seek information; ask a question or questions” (p. 738). The same dictionary lists numerous definitions for the term *active*. The best interpretation for this context is “causing action, motion, or change” (p. 14). Inquiractive, then, can be interpreted to mean, “to seek information; ask a question or questions causing action, motion, or change.” In other words, it means questions followed by action or action spurred by questions, that lead to further questions, or questions that set into motion or enact change. Real questions, taken seriously, will always influence a response. A negative example might be, *inquirinactive*, meaning, “to seek information; ask a question or questions leading to **no** further action, motion, or change. Does this kind of inquiry sound familiar?

The inquiractive classroom challenges the idea of asking questions merely for the purpose of asking or, in some cases, to elicit a predetermined response. Barnes (1992) comments:

They [*students*] have learnt during the years that most teachers only wish to hear the expected reply. That they do not want discussions that include divergent viewpoints and which raise different questions from theirs. (p. 127)

In such settings, the dialogue is restricted by the teacher's limited interest in his or her students' thoughts and ideas and an inflated view of their own. Even an acknowledgement on the part of the teacher of the value of divergent thinking would be a valuable first step.

Conversely, in the inquiry-based classroom we ask because we want to know, and when we ask, we do something with the ideas that are shared. The teacher, part of the "we," is not the originator of all questions, but must be the facilitator of meaningful inquiries, the primary force engaging learners by asking questions, answering questions, and maintaining an openness to the myriad of questions that will be asked by children, if given the proper guidance and space. The teacher must be open to asking questions and allowing children the space to ask their questions. The sustaining power in the inquiry-based classroom comes from the questions – how they are posed, the way in which they are valued, and the intensity with which their answers are pursued. It is the questions that give everything else purpose. Under the heading, "The Hermeneutic Priority of the Question" in *Truth and Method*, Gadamer supports this premise. He states, "It is clear that the structure of the question is implicit in all experience. We cannot have experiences without asking questions" (Gadamer, 1960/1989, p. 362). The implications of this statement are far-reaching.

Looking Back on Themes

Knowledge emerges only through invention and re-invention, through restless, impatient, continuing, hopeful inquiry human beings pursue in the world, with the world, and with each other. (Freire, 1970/2000, p. 72)

Revisiting initial themes uncovered in Chapter Two, *community*, *voice*, and *wonder*, along with newly emerging themes of the *active* and *interactive* classroom,

consider a classroom experience with all these essential attributes with the exception of inquiractivity. The classroom has an established sense of community and the children feel safe and cared for, but there are no opportunities for questions of any kind. Voice is valued and students can share their thinking and their emotions, but their questions go unanswered. The teacher allows the students to express all they are wondering about, even encourages the children to write their ideas in journals, but nothing is ever done with the questions. Questions are posed, even written, but never addressed. What happens to learning in such a space?

Now imagine the active classroom environment, a place that welcomes hands-on activities, where students are frequently seen out of their seats. The children are doing, laughing, and learning, but no questions are offered by the teacher, nor are any of the children's inquiries addressed. The teacher might respond to a student's question stating, "We'll have to look into that later!" Now visualize the room as not only active, but also interactive. Student-to-student conversations are taking place and the teacher allows dialogue throughout the instructional day. Yet, when it comes to questions, they are put on hold.

Place yourself in the following setting, imagining the experience through an observer's lens. You see an active classroom, alive with movement and freedom, coupled with interactive experiences, where students have opportunities to work together, discuss, and debate. The classroom is a place where voice is valued, community is developed, and wonder is encouraged. While this image may seem desirable from a teacher's perspective, it unequivocally does not capture the essence of the inquiry-based classroom. Without the presence and persistence of questions

combined with action, leading to more questions, we see an incomplete view of the inquiry-based classroom.

Another essential aspect of the inquiry-based classroom, or better stated, *the* primary component of the inquiry-based classroom, is the inquirative experience. Inquiry-based science without inquiry would not be inquiry-based, just as the Solar System, without Sol (the sun) would not be sun-based. Essential to the inquiry-based experience we see the centrality of questions. The meaning of *inquire* is to ask, and the meaning of *science* is to know. We inquire because we want to know. Gadamer (1960/1989) elaborates, “All questioning and desire to know presuppose a knowledge that one does not know; so much so, indeed, that a particular lack of knowledge leads to a particular question” (p. 366). Teachers, unaware of their students’ general knowledge base at the start of a unit of study, develop questions and activities to generate answers and questions. Children, too, come to the elementary space science classroom with questions and often many answers as well. They know, and yet they want to know more. Their curiosity can be overwhelming – and inspiring!

Asking

I ask the students to complete written responses to the question:
What do you wonder about space? I wonder...

(Note: In the following transcriptions of written student responses, the spelling and grammar remains in unedited form)

How big the sun is? How does the sun work? How big is the moon?
How does the moon work? Is there more than 8 planets? Is the earth
going to get sucked into a black hole? How big is space? What do the
stars mean? (Georgia)

How many new stuff is in earth? How big is a rockit ship? How hot is
the sun? Why is there holes in the moon? Is there food in space? How
cold is Pludo? Is Uranis colder then Pludo? Do shouting stars land on
planets? Do you find animals in sapes? (Sasha)

Why is Pluto not a planet? Why do eclipses happen? (Chad)

I wonder what novae are? I wonder what a solar collapse does? I wonder what black holes do or lead to? I wonder if there are different planets with life on them? (Gregg)

If Pluto is a planet? If Mars has aliens? Is a UFO real? Why are sometimes the clouds pink or a different color? Why is also sometimes the moon a different color? How many stars are in the galaxy? Do planets have moons? (Ella)

How many days, months or years it takes to get to space and the moon? And I wonder about black holes? Why do eclipses happen? Would we burn up if we are 30 feet away from the sun? How big is the sun, moon and earth? (Katrina)

What do black holes do to the earth? I wonder what would happen if the sun blows up! I wonder why does the moon turn yellow sometimes? (Karyn)

How many stars are in the sky? How many moons does each planet have? What would happen if there wasn't a moon? What would happen if there wasn't a sun? Why is Earth called Earth? How long does it take to get to space? How many astronauts so far have gone into space? (Brenda)

How many planets? When is the end of the world? (Doug)

Is there water on the moon? How many planets are there? I wonder about Pluto. How does a black hole work? What is a super earth? Can we live on the moon? (Jacob)

Why do they call it the Milky Way, is it made of milk? Sense Pluto not a planet why don't they blow it up? (Brunden)

I wonder if in a different galaxy if there is another planet with life and another place where there's learning a different covering animals? I wonder what another galaxy's name is? What is inside of a black hole to make it suck things in? I wonder in millions and millions of years later will there have different plants, water, food and other stuff? I wonder how planets form and what makes land a place in space, the entire place where there is land, water and space? (Roy)

Do other planets have moons. How many stars are in a galaxy? How many planets are in a galaxy? Is air gravity? (Ethan)

If a shooting star is hot or cold? How many stars r in a galaxy? If we woudn't have gravity would the water fall off earth? (Drew)

Why there's a sun in are atmosphere and why there is a day time and night time? Why is there planets? And why there is stars that you can't see in the day? Why is there gravity on earth and not any in space? Why is there space? Is there any other way to get into space other than roket ships? (Jacquelyn)

Have we found a live organizm in space? What would it be like with out the moon? Will the sun blow up? Will we get sucked into a black hole? (Reggie)

How long does it take to get to space?!!! Also is there really a new planet called SUPERPLANET?!! How far is the sun from the earth? (Cherry)

What I would wonder if we would die from the sun overheated? I wonder what if black hole suck us in the black hole? I wonder if the moon died out and the sun died out? I wonder how much the sun and the earth would weigh put together? I wonder how much strength gravity? (Jackson)

If there was no other planet other then space what if the was no earth were would we live? Why differint planets have sertant amont of suns? What if the milky way didn't igsist? (Sean)
(Student responses, January 25, 2010)

Today's lesson ends with my usual assignment: "Take a few minutes to write down things that you wonder about space." As I collect the papers Mrs. Z gives directions to prepare them for lunch. Like so many times before, I am given a collection of student-generated questions to take home and ponder. The "I wonder..." activity has become such an integral part of my practice for so long, I use it with little forethought. As Gentry and Mann (2008) remind us, "Children are naturally curious, and inquiry-based instructional strategies are designed to build their inquisitive nature" (p. 83). My purpose is driven by a desire to tap into the students'

curiosity, but in retrospect, my appreciation of the essential nature of questioning in the inquiry-based classroom has inadvertently waned.

Fortunately, the student responses, listed above have an awakening impact. As I read, I am drawn by their insightful inquiries. Included in the nineteen responses, there are eighty-eight questions, an impressive number. Each one suggests curiosity, interest, and a desire “to know.” I am drawn, once again, from a life of meetings and reports back into the enlightening world of wonder.

From Inquiry to “Inquiractive”

Sound teaching usually begins with questions and phenomena that are interesting and familiar to students, not with abstractions of phenomena outside their range of perception, understanding, or knowledge. Students need to get acquainted with the things around them – including devices, organisms, materials, shapes, and numbers – and to observe them, collect them, handle them, describe them, become puzzled by them, ask questions about them, argue about them, and then try to find answers to their questions. (Rutherford & Ahlgren, 1990, p. 188)

Over time, the inquiry-based classroom takes on a signature look. It is an active space. Students move, they touch, and they look. It is not passive. Often students interact through conversation and dialogue. It is not a quiet experience, though certainly there are times of quiet, thoughtful reflection and moments of pondering, thinking, reading, and writing. The questions, the ever persistent questions, continue to flow, growing in frequency and depth, as students become increasingly emerged and engaged within the content. Gadamer (2001) states, “In our experiences we bring nothing to a close; we are constantly learning new things from our experiences” (p. 53). It is this open, growth-oriented mindset to which Gadamer

refers that brings alive intense energy and inquiractivity in the space science classroom.

Initially, though, there can be a time of reluctance on the part of the children. The students take a risk when first posing their questions because they have no guarantee any response will be forthcoming. The “I wonder...” activity could be an exercise, like so many others, with no clear purpose. Hesitancy can sometimes be seen in children’s body language and demeanor in the elementary classroom as they wait for instructions as to what they must do next. Van Manen (2003) says, “When we meet another person in his or her landscape or world we must meet that person first of all through his or her body” (p. 103). I heed van Manen’s counsel, reacting to the tension I sense in their postures with non verbal cues that suggest warmth, care, and acceptance.

It is my responsibility, as the teacher, to respond to the students’ emotional needs, and also to do something of substance with their intellectual inquiries. I can demonstrate this to the students by keeping their questions in high regard. I start that night by typing the long list of student questions from the “I wonder...” assignment. The next day I take the list to one of the teachers at the school district’s Earth and Space Science Lab (ESSL), a state-of-the art STEM center and planetarium. Each student within the district in grades one through five visits the facility each year as part of their science experience. It is my intention to have the ESSL teacher consider the students’ questions and incorporate them into their visit, scheduled a few weeks later. Mrs. Z’s students are familiar with the facility and express excitement about the field trip, but they do not know that part of their visit will include opportunities to dig

deeper into their myriad of questions. The approach is novel to the ESSL instructor, but he embraces the inquiry-based strategy with enthusiasm. He agrees that if the students are to grow from their initial inquiries, time and space must be provided to address them – what better setting than at that special facility dedicated to the study of space?

In addition to the experience I planned for the ESSL, I present an idea to the class, proposing the use of the “I wonder...” responses as a warm-up or introduction each day at the beginning of our instructional time. The students’ affirmative response is encouraging. But, as van Manen (2002) so appropriately states, “Just because people share a space together that does not guarantee that conversations will happen” (p. 92). It is incumbent upon me, as the teacher, to provide an appropriate time and space to address, within the limited confines of allotted time, the numerous student questions. A simple acknowledgement to the class that we will get to as many questions as possible seems effective.

Over time, the practice proves to be beneficial, opening new opportunities for dialogue each day, while also demonstrating a high value for student inquiries. It is not difficult to connect student curiosity expressed in the questions with the intended lesson for the day. Jacquelyn, for example, wants to know about day and night and why there are stars you cannot see during the day. This line of questioning meshes perfectly with the lesson on rotation. Drew wants to know about shooting stars, a topic we will address during the lesson on comets, meteors, and asteroids. Many other students pose questions about the planets, which will become the basis for their

selection of planets to research for their planet reports (from written student responses, January 25, 2010 – see pp. 261-263).

Jardine, Clifford, and Friesen (2003) describe a similar and empowering classroom experience where written student work is read back to the class, allowing thoughtful expressions to be shared with the classroom community. They state:

Once such an art becomes part of the classroom climate, students themselves become increasingly willing to read the ventures of others in strong ways, ways that open up rich and luscious spaces for others. (Jardine, Clifford, & Friesen, p. 130)

In a standards-based setting, an inquiry approach can appear to take valuable time, leaving little for important content; however, in practice student interest becomes the force that brings engagement and enthusiasm to the classroom experience creating opportunities “that open up rich and luscious spaces.” Using relevant student questions as a warm-up activity not only addresses students’ questions beautifully, it also provides meaningful content connections while personalizing the experience for the classroom community.

Seven years after her 4th grade space science experience with Mrs. V and I (see Chapters One and Two), I ask former student, Aubrey, to share her recollections of the inquiry-based space science classroom. Her comments add insight to the question of addressing student questions in an inquiry-based setting.

Mr. Horne: Do you remember the inquiry aspect in the class that we had? Remember things that we did that you would classify as inquiry?

Aubrey: Probably mostly just getting us to ask, or ask the questions that we wanted to, and telling us not to be afraid to ask the questions because without the questions you wouldn't know what we were interested in, what we wanted. I remember that, now that I say it, that you were very, “Tell us what you want to learn and

we can teach that.” So it was important that we told you what we wanted to know and the questions we had so that you guys could mold your teaching to what we were interested in and not just what the curriculum said. Otherwise it would just be a curriculum-based classroom and not an inquiry-based classroom. (Conversation with Aubrey, April, 2011)

Aubrey’s recollections capture the essence of the “inquiractive” classroom experience. Children should be reminded that what they think and wonder matters to the teacher and that their questions are valued and considered – that answers to their questions should be pursued. The inquiry-based classroom becomes a space for thinking, asking, and doing. But we must be careful about how we consider these important elements of the inquiry-based experience. Aoki (1987) reminds us:

If we grant that “thinking and doing” are important human acts, is it always the case that we should think first and then act? Must we be caught up totally in the linearized form of “from theory into practice”? I think not. (Aoki, p. 358)

The inquiry-based experience must allow for greater freedom than a linear, think-plan-do approach. Too often a prescribed format is seen in science classes in the form of “labs” structured to pose a question and then lead the students to draw conclusions based on a controlled set of activities.

Over a hundred years ago, Dewey (1910) provided educators of the day with challenging alternatives to traditional classroom approaches. His ideas are still relevant today. He writes:

Reflective thinking is always more or less troublesome because it involves willingness to endure a condition of mental unrest and disturbance. Reflective thinking, in short, means judgment suspended during further inquiry; and suspense is likely to be somewhat painful. (p. 13)

Dewey is advocating for an inquirative approach that honors the struggle brought about by thinking while allowing the time to wrestle with new or confusing ideas. In such a classroom scenario, a question is posed or an engaging activity triggers a spontaneous question that leads to action, which is thought.

The inquirative classroom model challenges the traditional view of classroom interactions. Aubrey and I continue our conversation about her recollections of her space science classroom as she points out aspects of her experience that are contrary to an elementary science lesson:

Aubrey: I think if you had just told us everything out of a book and read to us just straight all the time, it would have, we would have been able to figure out, we're just here learning what we have to learn because this is what we have to do for school—

Mr. Horne: Hm-hmm.

Aubrey: —But making it hands-on and not just out of a book made it seem like, made it seem more like it was us who were in charge of the actual education. So I guess it wasn't apparent at the time that there was a curriculum exactly, but it didn't seem like there was one.

Mr. Horne: That's cool. And the idea is not to trick the students—

Aubrey: Yeah.

Mr. Horne: —into thinking that they're in control. The idea is that within the parameters of a classroom, a science classroom, an inquiry-based classroom, that if you allow students time to share what they're thinking and their ideas, many and most of those frequently match ways in which you can bring the curriculum to them—

Aubrey: Hm-hmm.

Mr. Horne: —in a way that allows for them to share what they wonder, to be participants. So I guess what I want to say is, it's not like a back-door trick but it's more of a, giving the students more ownership, making it more interactive. (Conversation with Aubrey, April, 2011)

By developing ownership of the content, Aubrey became more engaged and recognized that her thinking was valued. Wenger (1998) states: “Being included in

what matters is a requirement for being engaged in a community's practice, just as engagement is what defines belonging" (p. 74). Aubrey recognized that thinking in school matters, that her thinking matters, that the activity of the elementary space science classroom matters. She learns that she is valued as a member of the community of learners and part of a process that is engaged in a valuable learning experience. She elaborates further:

It's like teachers coming, bringing their students here to the lab [*The conversation took place at the district's Earth and Space Science Lab – ESSL*] and letting them touch all the fish—or not the fish but, you know, all the creatures—and then look at the rocks and touch things and see demonstrations. And it brings them into an environment where they get excited about asking questions instead of just showing them—again I keep saying the same thing—instead of just showing them in class. It makes students excited about learning, and it makes it, we ask more questions like, why does it feel so slimy? And then you can segue into different textures or something basic just out of bringing students into the kind of environment where they can, where they're encouraged to ask questions and experience things for themselves. (Conversation with Aubrey, April, 2011)

Aubrey's comments and recollections offer additional insight into the essence of the inquiry-based experience. She describes an environment "where they're encouraged to ask questions and experience things for themselves." When students are not offered such opportunities, opposing mindsets can develop. Block (1998) comments:

Too often students demand to be simply told what to do rather than be plagued with thinking about what they already do and what must yet be done. They don't desire to question but merely to answer. (p. 17)

This is not the kind of response indicative of the conversants in the study. In our classroom experience action and interaction often lead to inquiraction. Inquiraction leads to action causing interaction. Interaction stimulates inquiraction

which leads to action. Questions followed by investigations make space for discussions, collaborations, and further questions. The questions are not random or disengaged, but rather, they are interconnected with the activities and the particular needs of the students in the inquiry-based classroom. Block describes one extreme.

Jardine, Clifford, and Friesen offer an opposing view, stating:

... restlessness brought to the classroom by an individual child's question or concern or trouble or confusion is dealt with differently. The interpretive task is to open a space around the troubles so that, those troubles can be worked out, not just worked on. (p. 130)

Inquiractivity, an essential element of the inquiry-based classroom experience, gives priority to questions, invites thinking, does not reject trouble or confusion, but celebrates the struggles that lead to understanding. Once the students in the inquiry-based classroom recognize the openness to questions, how does the experience change?

Persistent Questions

To lose 4 million tons of its own substance every second of its existence would seem to suggest the the sun will vanish before long. No worry. Over the next 6 billion years, this rate of use will cost the sun only one forty-thousandth of its enormous mass. (Dubay, 1999, p. 136)

Parents will try to tire out their toddlers by letting them play hard, with the plan in mind to wear them down so they will go to sleep early. I have tried this, too. It usually does not work. Like the sun, their fuel seems inexhaustible. In the inquiry-based classroom, a “wear them down” strategy of allowing time for questions may not pan out as intended either. Experience tells me that opening the floor to student questions about space, yields a never ending stream of curiosity driven inquiries. Children's capacity to question seems insatiable. As Hammer and van Zee (2006) put

it, "...children should see and experience science as about finding ways to answer interesting, meaningful questions" (p. 174). When they see and experience science this way, the questions will always follow.

During one of many conversations with small groups of conversants, a comment is made about the NASA mission to Pluto. The reference to Pluto prompts Jacob to redirect the discussion focused on student experiences in the space science classroom. He begins, then Chad joins in:

Jacob: When will the spaceship end? When will the spaceship just stop?

Mr. Horne: The way that things work in space is that the *New Horizons* mission will keep going forever.

Jacob: It won't stop?

Mr. Horne: It can't stop, unless it hits something. But it will stop, at some point it will stop sending us data back because the batteries, and the computers will break or the batteries will wear out. Eventually it will stop working, but the ship itself will go on forever. Until or unless it gets hit by something, or bumped or destroyed. Because that's how space works, there's nothing to slow down that ship, it will just keep going at 40,000 miles an hour forever.

Chad: Won't it run out of gas or something?

Mr. Horne: It doesn't need gas. Once a thing, and this is something you'll learn later in middle school and in high school, once a thing gets going in space where there's nothing to slow it down.

Chad: Will it come back to Earth?

Mr. Horne: No. There's nothing to slow it down. It's not going fast because it has gas, it's going fast because we used energy to send it. And it'll keep going forever because there's no friction, there's no air, there's nothing to stop it, it'll keep going forever and ever, unless it hits something. (Conversation 4, April 1, 2010)

As a teacher, I am confronted with a decision. Should I redirect the group back to the discussion I was leading or yield to the question at hand? The students are curious about Chad's question focused on Newton's Laws of Motion as they apply to

a current event. I am cognizant of the fact that these concepts are part of the middle school curriculum, but my intuition in the moment presses me to respond. Later, as I reflect on the turn of events, I recall the story of a 3rd grade student, Ken, who walked into his kitchen and seemingly out of nowhere asked, “Mom, are there numbers below zero?” She turned, startled and with little thought, answered, “Well, yes, there are.” Ken walked away with no additional questions or comments, went to his bedroom and invented an ingenious way to solve subtraction problems that require regrouping. This student, along with his mother, had years earlier articulated the entire story to me. Ken shared with me that he had asked the question about numbers below zero at school but was told by his teacher that they would not learn about such things until a later grade. His desire to know outweighed the lack of response from his teacher. Later, his teacher told me he did very poorly on his math facts, but was excited to learn that he had taken personal initiative to seek deeper understanding. His story, too, is informative for the inquiry-based experience. In *What is Called Thinking*, Heidegger (1968) writes:

To learn means to make everything we do answer to whatever essentials address themselves to us at a given time. Depending on the kind of essentials, depending on the realm from which they address us, the answer, and with it, the kind of learning differs. (p. 14)

In the first example, Chad and Jacob, pursuing “whatever essentials address themselves” to them, seek understanding in the course of a classroom conversation. I make a pedagogical decision to respond. Ken also sought understanding, and when he did not receive needed guidance at school, found another way to learn that which was essential to him. In both cases, young students are seen actively addressing a desire to learn through inquiry – a notable pursuit of knowledge.

Of course, one could argue about the limited time available for instruction, the massive curriculum, or the pressure to perform on state mandated tests as reasons for limiting time devoted to student inquiries. These challenges are all very real to educators. Yet, when our students wonder aloud, how should we respond? One teacher chose to avoid a student's question. I chose to discuss the question about the motion of the rocket through space. Was my response adequate? Do Jacob and Chad feel satisfied with the answer? I hope not! There is a possibility they will persist with their wondering, look into it more closely, think about it more deeply, question their own thinking, and over time, further develop their understanding. Whether teacher or student initiated, asking and then doing something more is inquiractivity! As the teacher, did I answer too much, without asking them more questions to engage them? Like Ken, would Chad and Jacob have found another way to pursue understanding to their curiosities had our conversation been cut short? Perhaps. But the pedagogical demand of the inquiry-based classroom is to create the kind of community that invites learners to think and thinkers to learn. Aoki (1987) explains:

... one's ways of knowing, thinking, and doing flow from who one is. Such a person knows that an authentic person is no mere individual, an island unto oneself, but is a being-in-relation-with-others, and hence, is, at core, an ethical being. (p. 365)

Relationships in the inquiractive classroom are key, and so are the questions. Yet, as a teacher, where do we draw the line? One cannot fully attend to every question, nor can indefinite opportunities for meaningful interactions be provided. Student conversants in this study never demanded time for questions, though they did appreciate the opportunity to ask questions and inquiract with their peers when the

opportunity was given. In another example of student inquiry, Gregg comments and poses several questions:

I have three questions. The first thing I wanted to say was I have a theory against the UFOs invading our planet. If they tried to get into our planet wouldn't they be swept by the orbit before getting to it? ...My other two are what are supernovas and black holes?
(Gregg, Conversation 4, April 1, 2010)

Gregg offers these ideas and questions because it is a safe setting to do so.

Had the invitation to inquire not been given, these comments might never have been shared. Each of the concepts he brings to the group reach far beyond the scope of the curriculum. He does not know that, nor does he care. The important thing is that he is able to articulate questions, even when they are not all able to be addressed. With an inquirative mindset, Gregg will pursue answers on his own or with the help of others such as a parent, friend, or librarian. A role of the teacher in the inquirative classroom is to encourage questioning and promote a spirit of seeking answers within and beyond the classroom.

Student Ideas About Inquiry

But it is not our aim to impress children with whatever facility we have with the language of science or to insist they parrot it back to us. Instead, we need to draw them into it slowly, carefully develop their capacity to use it and, above all else, make sure that what we say and what they say is meaningful to them. The science the children do must be accessible to them. (Newton, 2002, p. 23)

Getting to the essence of the inquiry-based space science experience requires us to inquire about inquiry. To extend our thinking about inquiry means we must question one another about questioning. This meta-inquiry is not meant to plant ideas in children's minds about the meaning of inquiry, but to lead them to honest discussions of the lived meaning of the space science classroom. As I introduce the

term inquiry-based science into our conversations, I attempt to do so with a tone that suggests it is a topic to discuss, not a question for which I expect a specific answer.

Here is a snippet of a conversation:

- Mr. Horne: You're doing something in our class and it's called inquiry-based science...Does anybody in here even know what that is? What am I talking about?
- Jacquelyn: Questions.
- Mr. Horne: Questions! Inquiry-based questions, inquiry-based means inquire, and when somebody inquires, they ask questions. So when you do the hands-on, it should, it can, it might, lead you to—[*Roy finishes the thought*]
- Roy: Questions.
- Mr. Horne: And if you're in a class and no questions get answered—
— [*several students interject at once*]
- Student: You don't learn anything, you're not learning really.
- Mr. Horne: What about a class where the teacher tells you all the things that you're supposed to learn?
- Roy: Then you're not learning because you don't get how it's supposed to work, then you might just forget what it means.
- Mr. Horne: So here we are, we're on this inquiry thing. Inquiry is questions. So your science class is about questions—
- Students: Yeah.
- Mr. Horne: —instead of answers. But I told you at the beginning that you can give me some questions and I'd give you some answers, right?
- Roy: That's different kinda, because when we're learning we're gonna ask questions and you're answering it in a way but you're telling us how it works and why it works. (Conversation 1, March 29, 2010)

These students express the idea that the format of the inquiry-based science class allows them the opportunity to ask their questions. Roy's comment, "...when we're learning we're gonna ask questions..." reveals the inquirative mindset he holds. Roy recognizes that in the inquiry-based classroom it is safe to pose questions, not simply answer them. As I reflect, this truth becomes a revelation. In the rush and intensity that exemplifies the elementary classroom, it is easy to lose focus on the essential,

getting lost in the parts without a view of the whole. Van Manen (2003) helps me to regain a proper focus. He provides this insight:

In any adult-child situation we should always ask what is pedagogically the responsible or right thing to do for the children entrusted to our personal care. (p. 155)

His words direct me back to the essential and I wonder: What is the meaning of questioning to students? How do they experience the classroom that is open to their questions? What is the inquiry-based experience in Mrs. Z's classroom like for them? In June, months after the space science unit ended, I ask students to provide written responses to the prompt, "What is the meaning of inquiry to you?" (see Appendix D).

Here are several student replies:

Asking questions then finding facts. When we ask questions we find our information. (Ella)

Inquiry means to ask questions to someone about space, language arts, anything. (Katrina)

Asking questions, learning new things. I ask questions in Mr. Horne's class. I learn new things and sometimes examine things. (Brenda)

I like inquiry class because you can ask about what you don't understand like maybe why does it get dark at night. I learn more in an inquiry class. It helps me more. (Roy)

I feel good that I could ask questions. If I couldn't ask questions everything would be boring. (Ethan)

To ask a question to find evidence and investigations to find the answer! If we didn't have inquiry we wouldn't have learned what we know now. (Karyn)

The prominent word found in each of the responses is *ask*, defined by *Webster's New World College Dictionary* (2001) as, "to put a question to (a person); to inquire of" (p. 83). In a typical classroom scenario, teachers ask questions and

students answer them. There is nothing wrong with that! Intense professional development efforts are frequently made to write questions that challenge students to think and respond at increasingly sophisticated and challenging levels (for example, Bloom's *Taxonomy of Educational Objectives*). Questions are often designed not only to test students, but to teach them. But, how do students in the inquiry-based science classroom experience varying levels of questioning? In what manner might Bloom's Taxonomy have a flattening effect on questions? Aoki (1987) offers perspective:

For a curriculum to come alive in the classroom, the curriculum itself has to contain, said or unsaid, an invitation to teachers and students to enter into it. Not only that, there needs to be a reciprocal invitation. The curriculum-as-plan must wait at the classroom door for an invitation from teachers and students. And when the curriculum, teachers, and students click, we are likely to find a live tension that will allow the teacher and students to say, "We live curriculum"... (p. 362)

A living classroom is inviting. The curriculum invites participants to enter in. The teacher's list of questions organized according to Bloom's Taxonomy transforms from "curriculum-as-plan" to a living document, applied when appropriate as a dynamic interplay of student questions, curriculum objectives, and the teacher's content and pedagogical knowledge. Teacher and students interact in a wonderful tension that creates an exciting learning environment.

Turning to the conversants' responses, they support a view of inquiry that places a high value on their own questions. Of the 17 responses from conversants (see Appendix D), none indicate a conception of inquiry as only teacher-directed questioning. Jacquelyn's response is vague. She writes, "To me it means to request a question. Or even request an answer!" The person requesting could be teacher or student. Sean does not use the term *ask*, but links inquiry to questions. He states:

I think inquiry is a question or an investigation. Also it's a discovery of information. So that means what do you think of having a space room? I love it and also I'm learning a lot. (Sean)

Sean's response shows the interplay of question and answer. "Inquiry is a question," he states, but it is also "a discovery of information." Sean goes on to report that he is learning a lot. His comments add to the evidence that children in the space science classroom love learning, value the opportunity to ask, and appreciate the willingness of the teacher to answer. As stated in the *Experience Science Teachers Guide* (2007) the inquiry process, "...is not a single method with a set number of orderly steps. It is a flexible process for both asking and answering questions about the universe" (p. x). The flexible process of asking and answering applies equally to the teacher and student in a truly inquirative setting.

During one-on-one conversations with two of Mrs. V's former students, now in 11th grade, I ask them to share their interpretation of inquiry. Paula responds this way:

Science is all about asking questions. And maybe not giving the, like one answer but theories and theorems to that. So I guess that's – wouldn't science all be inquiry-based? (Conversation with Paula, April, 2011)

She never says more about who might be asking the questions, or who will be answering, but her question at the end of the quote is thought provoking. In some sense, perhaps all science teaching and learning, or all school learning, for that matter, should be linked to inquiry. School is a place of questions and answers. All questioning is based upon the premise of seeking understanding in an inquirative way. Dewey's work on thinking brings insight, reminding us of the nonlinear interplay of purposeful thinking, acting, asking, and doing. He writes:

...observation is an *active* process. Observation is exploration, inquiry for the sake of discovering something previously hidden and unknown, this something being needed in order to reach some end, practical or theoretical....observation proper is searching and deliberate. (Dewey, 1910, p. 193)

Aubrey's response to my inquiry about inquiry demonstrates an inquirative mindset to questions and the process of seeking answers. She states:

If I want to know something I need to ask questions and I need to be able to explore what I want to know myself. I shouldn't necessarily wait for someone to come to me and ask certain questions like that. I have to pursue my own interests. In pursuing my own interests I have been able to broaden my range of interests because asking one question always leads to ten others, even though you might get one answer. (Conversation with Aubrey, April, 2011)

When Aubrey says that "asking one question always leads to ten others" an immediate sense of *reverse-déjà vu* floods over me. This is precisely the statement I made to Aubrey and her classmates seven years earlier. Now she is using my own words back to me. Could she possibly have learned this from her inquiry-based classroom experience in 4th grade? Has the experience of the inquiry-based classroom lived with her all these years? How has the experience impacted her current thinking?

Teacher Ideas About Inquiry

Using inquiry learning as a way of learning throughout this space classroom has been really beneficial for my students. And I see them now incorporating that way of learning into all their content areas that I teach every day. I'm seeing them ask a lot more questions, even in the math classroom, and in the Motion and Design unit that we've been doing throughout the past few weeks. (Conversation with Mrs. Z, June 8, 2010)

The inquiry experience highlights a way of learning, not just a technique for teaching. The carry-over of this kind of learning space is indicated by her comment,

“I’m seeing them ask a lot more questions, even in the math classroom and in the Motion and Design unit...” Increasingly, the students are becoming the ones asking the questions, not just during the space science instruction, but throughout the day, and throughout the remainder of the school-year. Barnes (1992) adds perspective:

Teachers will wish to know what alternatives there are to teacher-dominated discussion. How can pupils be given a more active part in learning without being abandoned to their own devices? (p. 131)

The question posed by Barnes challenges us, as educators, to be attentive to students’ need for less teacher talk. As Mrs. Z struggles with the issue, she goes on to state:

Well, the children feel more comfortable asking questions. I have noticed that. I’ve noticed that they have felt more comfortable asking questions to their neighbors as well about just the things that we’re learning, or things in general. And it isn’t a completely, it is, I just feel as though it’s not a completely different way to teach. You know, you do teach based on the framework that’s set up. But then, you know, it’s just a different way. And I think that being exposed to it helps me feel more comfortable and the children to feel more comfortable...So I’ve definitely learned a lot of, seen a lot of benefits from my students within their own question-asking and in their own being comfortable in the classroom, as well as myself. (Conversation with Mrs. Z, June 8, 2010)

Major emphasis on the word *comfort* is given throughout Mrs. Z’s statement about inquiry. She and her students have adapted to an inquirative setting. A place of safety and space offers an increasingly comfortable place for questions to be asked by a student to the teacher, from student to student, and from teacher to students.

But, is school meant to be a place of *comfort*, meaning “a state of ease and quiet enjoyment, free from worry, pain, or trouble” (*Webster’s New World College Dictionary*, 2001, p. 292)? It would be difficult to find a parent, teacher, or administrator who would disagree with a call for schools to be “free from worry, pain, or trouble.” Teachers and students want to be at home within their classroom,

experiencing a setting free from anxiety. In such a setting, true learning, true creativity, and true meaning can be experienced at a high level. Sometimes, however, “a state of ease and quiet enjoyment” is not necessarily the intended setting either. The inquiry-based learning environment is often challenging. It is hard-fun, not just an easy experience. The enjoyment is experienced through the satisfaction of knowing, learning, and overcoming. Perhaps the children in the inquiry-based classroom seek acceptance and encouragement more than comfort. Washor and Mojkowski (2006/2007), writing about rigor in the science classroom, state:

Truly rigorous learning – both academic and nonacademic – involves deep immersion in a subject over time... a rigorous experience is reflective and intimate. A rigorous project causes students to take some type of action, to develop their own questions, to observe and retain key information, and to realize how hard it is to do something well. (p. 85)

Mrs. Z reports that she and her students became “comfortable” with an atmosphere open to questions. Instead, it may be the case that they are merely adapting to a way of being in the classroom with which they are not familiar – a way of being that seeks challenges that are difficult yet rewarding. Jardine, Clifford, and Friesen (2003) make this observation:

The generous, expansive, and exciting ways children know the world outside the school become cramped and penurious within its walls. The banquet of experiences that feeds all their senses, touches their hearts, and moves their souls shrinks to an anorexic diet of activities, drills, and worksheets. (p. 95)

How does the inquiry-based classroom experience compare with the way children come to know the world outside of school? In what ways does the inquirative nature of the space science classroom open opportunities for students to experience ways of

knowing that are generous, expansive, and exciting? How does student curiosity impact student experience in the inquirative classroom?

Curiosity and Wonder

The physical universe is a subject in which many ideas make high demands on students' comprehension and imagination... it is important that all students develop a sense of the context of place, time, and physical interactions in which their lives occur. Students in the early years are especially curious about how the world works. (American Association for the Advancement of Science, 1993, p. 60)

When asked, "What do you wonder about?" 4th graders in the space science classroom frequently respond with a series of questions. Their curiosity, when allowed room to stretch, is usually ready to expose their lack of knowledge and their desire to know. During a conversation with Jacquelyn, an interesting subject comes up. Here's a section of our dialogue:

Mr. Horne: So you answer questions in math. And in science, you answer questions. But you also ask questions.

Jacquelyn: Mm-hmm.

Mr. Horne: Do you ever have a chance in math class to ask questions like, hey, how come, or why does this work the way it does? Do you ever do stuff like that?

Jacquelyn: May—maybe if, like you're confused but we never ask what we wonder. (Conversation 6, April 8, 2010)

Is the reason there are rarely questions of wonder in the math class because the content does not lend itself to such an exercise? I wonder why curiosity and wonder would be limited to science? Is there space in the mathematics classroom for students and teachers to work in a more inquirative way? What are the obstacles to this kind of teaching and learning?

Mrs. Z shares the impact of wonder questions used in a subsequent science module. She states:

Having a chance, even in our Motion and Design unit, which we've been doing recently...I've been able to ask questions like, "What do you wonder about engineering? What do you wonder about how vehicles move?" And watching the children kind of stem off of that and ask more questions and then be able to respond to each other's questions and be like, "Well, I have something to share," has been really beneficial. (Conversation with Mrs. Z, June 8, 2010)

The essence of the inquiry-based science class, as the conversants experience it, includes ample opportunities for children to pursue their curiosity through questioning. Mrs. Z observes increased student-initiated questioning, simply by allowing them additional time to express their thinking.

Rutherford and Ahlgren (1990), support this notion: "Science, mathematics, and technology do not create curiosity. They accept it, foster it, incorporate it, reward it, and discipline it – and so does good science teaching" (p. 190). How does good science teaching foster, incorporate, reward, and discipline creativity? I want to know. As an educator, I strive to foster creativity in students and look for ways to incorporate flexible thinking into their lived experience.

When given extended time with the group of conversants, I attempt to create an atmosphere of openness and acceptance during our conversations. I want the students to feel free to share their curiosities about the space science classroom in a collaborative and conversational way. Setting such a tone is not difficult. Weeks and months of interaction lead to a deepening of relationships between the students and me. The small group conversations are a natural extension of the classroom experience. The student conversants do not treat the conversations as substantively different from all the prior conversations we have had throughout the time of

instruction in the space science classroom. As such, a notable, yet unintended consequence results.

What About Our Questions?

Most of us know that this global village [earth] is a little less than eight thousand miles in diameter, and that over a million Earths would fit tidely into our sun, which approaches a million miles from edge to edge. It would take a jet plane flying from the sun's surface at 500 miles per hour well over a month of nonstop flight to reach the star's center. (Dubay, 1999, p. 133)

The sun is so unimaginably vast that it is difficult for us to comprehend its magnitude, even with descriptive language such as Dubay's explanation above. Equally incomprehensible to me is how to find a way to articulate the depth and magnitude of student questions posed to me during the inquiry-based experience, and throughout our conversations.

As I met with the student conversants, I sought to engage them in conversations that would express, in a lived sense, their experiences. Phenomenological research requires a serious commitment to the work of holding meaningful conversations. *Webster's New World Dictionary* (2001) defines *meaningful* as, "full of meaning; having significance or purpose" (p. 891). As students actively participate in inquiry-based science, they are drawn to that which engages them – that which calls them. As a researcher of the lived experience of children in the inquiry-based classroom, I seek to uncover that which significantly engages the whole of the child. At the heart of this study I have an obligation and desire to create space for students' voices and, ultimately to allow them to tell their stories. Van Manen's counsel proves useful, once again, as I press forward. He offers this reminder:

Phenomenological projects and their methods often have a transformative effect on the researcher himself or herself. Indeed, phenomenological research is often itself a form of deep learning, leading to transformation of consciousness, heightened perceptiveness, increased thoughtfulness and tact, and so on. (van Manen, 2003, p. 163)

During each of the conversations, I sought to open that space, while at the same time remaining cognizant of the questions I needed to ask in order to uncover the meaning of their experiences. Relative to the research questions I posed over and over, the students were consistently excited about having the opportunity to share their ideas and their thinking with me, and time after time they engaged with my questions while also sharing their own. They want to help. But, no matter what questions I would ask, or how painstakingly I would try to direct them towards a particular focus, such as the lived meaning of inquiry, without fail, someone would redirect the conversation by posing a space related question. After several days, it started to feel like a conspiracy. I began to think, “Surely they are gathering on the playground and plotting together to undermine the research study.” Of course this conspiracy theory is absurd. These children were bursting with questions. Perhaps some explanation can be found in this quote:

After all, a lesson or two does not provide much time to explore ideas, become familiar with them, relate them to others, try them out and, in short, make them their own... The children’s somewhat delicate understandings need cultivation... Our aim is for children to establish a meaningful and well-integrated understanding of the topic. Science conversations are intended to support that process. (Newton, 2002, p. 117)

The amount of time given in 4th grade to the study of space within the school district amounts to little more than twenty hours of instruction. For children who are engaged and curious, this is woefully inadequate. The student conversants came to the

conversations hungry for answers like ants on honey. To honor their curiosity, I always attempted to respond to their questions. The result? More questions!

The experience of holding conversations, from my perspective, is exhilarating. After a few meetings, I came to expect the questions – look forward to them. I was determined to keep each new group on task, but also maintained a resolve to respond to their inquiries to the best of my abilities. One day after school, Mrs. Z asked how the conversations were going. My response was direct. “They ask a lot of questions!” With a smile and a nod, she acknowledged my response with a knowing look, following with, “What are you finding out?” In the midst of the process and at that moment in time, I did not have a well reasoned reply. Instead, all I could manage was, “They still have a lot of questions!” My response represents an acknowledgement of their voracious and incessant passion for understanding and my adamant approval of their undying curiosity. The class is an inquirative teacher’s dream come true.

The following condensed set of questions exemplifies the sense of interest and enthusiasm for space science the conversants express: “Do you think – question for you – do you think there will be any human existence on any other planet in the future?” (Brenda, conversation 5, April 1, 2010). “Well, I, I actually wondered why stars are not in our atmosphere” (Jacquelyn, conversation 6, April 8, 2010). “So how come Venus is hotter than Mercury if it’s closer to the sun?” (Georgia, conversation 8, April 16, 2010). “And like what would happen, let's say, if a planet went in a black hole, like what would happen to the planet? Like let's say if earth was in it, even though it's impossible...” (Roy, conversation 12, June 10, 2010). “Yeah. Like, how

are the planets made and, like, why did they get their color?" (Ella, conversation 18, June 10, 2010). "How long does it take to get up to outer space and to the planets and everything?" (Cherry, conversation 19, June 10, 2010).

Ann Sullivan, describing her experiences as Helen Keller's teacher, gives insight into such persistent questions:

She has now reached the question stage of her development. It is "what?" "why?" "when?" especially "why?" all day long, and as her intelligence grows her inquiries become more insistent. I remember how unbearable I used to find the inquisitiveness of my friends' children; but I know now that these questions indicate the child's growing interest in the cause of things. The "why?" is the door through which he [sic] enters the world of reason and reflection. (Keller, 1903/2003, p. 164)

Like Helen, the conversants have a strong desire to know more. The presence of such persistent questions is indicative of the students' passion to learn. Hammer and van Zee (2006) offer a rationale for the students' passionate interest. They state, "In science, we ask questions because the answers will help us make progress in some way toward understanding what things happen in the world and what makes them happen" (p. 172).

Could it be that simple? I ask the conversants for an explanation about their hunger for more knowledge, hoping to gain insight. I want to know what fuels their passion to know:

Mr. Horne: I want to know *why* you have so many questions! Like, every time I bring a group together, including you all, you always have all these questions. Why is that?
Sasha: Because there's a lot of questions to ask because, there's a lot of questions to ask on anything in the world. And like you could ask questions on space or different countries or different planets.
Mr. Horne: Well, you all ask me space questions.
Sasha: Because space is huge!

Mr. Horne: Well, why do you want to know?
Sasha: So one day we would know like much about space.
(Conversation 9, April 16, 2010)

Sasha, you might recall from her student profile, is the kind of student who often questions the structures of school. She is funny, smart, curious, and self-assured, but not a student who entered the space science classroom with much interest or background in space science. That truth highlights the beauty of this exchange. It demonstrates the power of the inquirative experience to light up a life. She has developed an interest because there were opportunities to ask questions. She was given time and space to formulate questions and additional space to pursue answers. The space to pose questions empowers Sasha. In this bright moment her essence shines brilliantly. With her newfound curiosity about space, she shines as a bright star that illuminates the space science classroom. Applebee (1996) adds insight:

The recognition that classroom discourse mediates between broader cultural traditions and schooled knowledge leads to a new way to think about curriculum and instruction: a curriculum provides domains for conversation, and the conversations that take place within those domains are the primary means of teaching and learning. Through such conversations, students will be helped to enter into culturally significant traditions of knowledge-in-action. (p. 37)

Sasha exemplifies the power of the inquirative classroom to transform learners with, what Applebee calls, “knowledge-in-action.” It is such knowledge, given space, and allowed to time to interact, empowered by conversation in a caring, curious, and enthusiastic setting, that gives power to the ultimate source of light in the classroom – the students!

Our Source – The Sun

Sunlight, which darts through space at the dazzling speed of 186,000 miles per second, takes ages to emerge from the dense interior of the

Sun. Light advances only a few miles per year near the Sun's core, where the crush of matter repeatedly absorbs it and impedes its escape. Radiating this way, light may journey for a million years before reaching the Sun's convective zone, there to catch a quick ride up and out on rolling eddies of rising gas. (Sobel, 1995, p. 22)

Light grows to unparalleled speed and with blinding intensity as it travels from our sun to earth, offering us nothing less than our existence. Where would we be without the sun? How can the significance of our energy source be measured?

In the space science classroom, where would we be without the questions? How can the significance of the questions in the inquirative classroom be measured? If there were but one essential element of the inquiry-based classroom it would found in the inquirative experience. Students thrive on the invitation to ask and the opportunity to act on their questions. Questions are the source of light that brightens the classroom. The work of the light is illumination, which gives the essential setting necessary to learn and understand. Light keeps us from being paralyzed in the darkness. It is the provision that allows us to find direction. It is light that provides a means for action.

Once again, as in previous sections focused on the active and interactive themes, conversant quotes offer a poetic expression of their voice to bring a sense of the intensity of their experience in the inquirative inquiry-based classroom.

That's What I Was Wondering...

You can ask questions about it.
Like do they stay in space because they float?
I keep on wondering what if we got sucked into a black hole.
It's not like they just tell you all the answers then you have a test.
Some will basically never be answered like—if like space goes on forever.
Then you're not learning because you don't get how it's supposed to work.
When we're learning we're gonna ask questions.

I ask questions in Mr. Horne's class.
You're telling us how it works and why it works.
When does *New Horizons* reach Pluto?
Well, I, I actually wondered why stars are not in our atmosphere.
Asking questions then finding facts.
When we ask questions we find our information.
I have three questions.

Inquiry means to ask questions to someone.
About space, language arts, anything.
Asking questions, learning new things.
I learn more in an inquiry class. It helps me more.
If I couldn't ask questions everything would be boring.
Being in an inquiring class is fun,
Learning stuff and getting asked questions.

To ask a question to find evidence.
What are supernovas and black holes?
I learn new things and sometimes examine things.
Why can't like you see space, but you can see the sun and the moon?
If we didn't have inquiry we wouldn't have learned what we know now.
I think inquiry is a question or an investigation.
Also it's a discovery of information.

What do you think of having a space room? I love it!
Ask some more questions... Because space is huge!
You're like a real scientist,
How are the planets made and, like, why did they get their color?
I have a theory.
Without any technology, would we be anywhere right now?
So one day we would know like much about space.

I have a question. Why isn't Pluto a planet?
I feel good that I could ask questions.
Because there's a lot of questions to ask.
But why doesn't space have oxygen?
People are saying that space never ends, but I'm wondering if that's true.
I like inquiry class because you can ask about what you don't understand.
Do hurricanes come from space?

I have a thought.
What's at the end of the end of the end?
I wonder if we're ever going to figure out if space really does end.
That's exactly what I was thinking.
But I have one question.
So how come Venus is hotter than Mercury if it's closer to the sun?

I still wonder!

(Compilation of student comments revealing the *inquiractive* theme, 2010)

The inquiractive nature of the inquiry-based classroom is essential to the experience just as the light of the sun is essential to life on earth. The space science classroom rumbles with activity, interactivity, and inquiractivity – radiant energy making the experience intense, enlightening, and impacting. The inquiractive theme, explored here, like the active and interactive themes explored in the previous sections, opens meaning to various aspects of the lifeworld experienced by students in the inquiry-based classroom. In closing, I examine the overall effect of the children’s inquiry-based experience.

From Darkness to Light

It was my teacher’s genius, her quick sympathy, her loving tact which made the first years of my education so beautiful. It was because she seized the right moment to impart knowledge that made it so pleasant and acceptable to me. She realized that a child’s mind is like a shallow brook which ripples and dances merrily over the stony course of its education and reflects here a flower, there a bush, yonder a fleecy cloud; and she attempted to guide my mind on its way, knowing that like a brook it should be fed by mountain streams and hidden springs, until it broadened out into a deep river, capable of reflecting its placid surface, billowy hills, the luminous shadows of trees and the blue heavens, as well as the sweet face of a little flower. (Keller, 1903/2003, p. 39)

Helen Keller’s glowing words of praise for her teacher are inspirational.

Statements like “her quick sympathy” and “her loving tact” challenge me to strive to make the classroom a place of transformation for children. First and foremost, I long for the students in my care to learn, to grow, and to thrive. My passion is for their success. It is the desire of every true teacher to see his or her students come alive as

Anne Sullivan experienced the transformation of her student, Helen Keller, from a place of utter darkness to one of light and life and hope.

The primary intent of this work is to share the classroom experience through a process of writing. Van Manen (2002) says, “To write is to be driven by desire” (p. 246). I have a passion to tell the stories of my student participants, to share their Heartsongs, to illuminate their Being, and to give a textual expression of their perspectives. Through the process of uncovering the hidden, bringing light to dark places, and writing my way to understanding, themes have emerged and children’s voices have been shared. Whether or not the light of understanding reaches the reader, I cannot be certain. The sobering limitations of this work are captured here by van Manen:

At the best of times, writing always falls short of its ambition to capture meaning—it reduces the experiential to the conceptual, otherness to sameness. (van Manen, 2002, p. 248)

Have I captured the essential, articulated the experiential, given inspiring light to the uniqueness of the inquiry-based experience? I wonder, yet this is not my question to answer. I have sought to remain true to the structure of phenomenological inquiry, sought to shed light on the deeper meaning or significance of the inquiry-based classroom experience, and sought to provide illumination of that which may have been previously unseen. But all that is “out there” is not to be seen. O’Donohue (2004) reminds us:

What we see, we see in light; yet what we see is always partial, a selection from the full spectrum of what is there but not visible to us. There is a real world of invisible light here around us but we cannot see it. Though we feel at home and sure in the visible world, it is in truth, a limited place. (pp. 86-87)

While recognizing the limiting factors of the scope of our vision, we can be encouraged by the example of Helen Keller who, seeing no visible light, was able to visualize objects unseen, describe light and shadow, and see beyond her dark and silent world. We might imagine her world as unbearably confining, but she sees beyond what we can imagine. Yes, we may be restricted to a small spectrum of visible light, but we still have access to an overwhelming display of color and light.

Students in the inquiry-based classroom, like so many celestial objects in the universe, are active, revealing to us motion, speed, change, and beauty. These dynamic students uncover their reflective, interactive nature, influencing one another, displaying color, absorbing, but also always giving, shining a great light that is not their own. These fascinating children are, by nature, inquirative, bursting with questions, ready to find answers, serving as sources of intense light, blinding in intensity, and overwhelming in energy. They inhabit the landscape of the inquiry-based classroom with questions and answers and action and interaction. They make the invisible visible. They bring light to the darkness. They illuminate the inquiry-based space science classroom!

The Inquiry-Based Space Science Classroom

I really appreciate you choosing this classroom to work with. I think that it has really opened my eyes into the different ways that I can use inquiry-based learning in the classroom. And I think that it's opened the children's eyes as well. (Mrs. Z, conversation, June, 2010)

Eyes open; receiving light; making meaning. What do they see? How do they experience the inquiry-based classroom? What is the lived meaning of inquiry-based learning? What does the research mean to the educational community? How might it

impact the pedagogical practices of educators in the future? Van Manen (2003)

provides a description that frames the work of this chapter:

Pedagogy is the activity of teaching, parenting, educating, or generally living with children, that requires constant practical acting in concrete situations and relations. ...pedagogy requires a phenomenological sensitivity to lived experience (children's realities and lifeworlds). Pedagogy requires a hermeneutic ability to make interpretive sense of the phenomena of the lifeworld in order to see the pedagogic significance of situations and relations of living with children. And pedagogy requires a way with language in order to allow the research process of textual reflection to contribute to one's pedagogic thoughtfulness and tact. (van Manen, 2003, p. 2)

The textual expressions of student voice found in this chapter seek to provide a window into the conversants' experiences, a taste of their stories, and a glimpse at the core of their being. In this culminating poetic rendering, student talk revealing lived language from the *active*, *interactive*, and *inquiractive* themes, are combined to provide a thoughtful depiction of their combined voices to bring a sense of the impact of the lived experience in the inquiry-based classroom.

Space Science Inquiry

It's active...

You get to do experiments...you get to test things out.

When you get up, you, like you learn more.

She let us touch it too.

You might even understand it better when you move.

I like moving around and having fun.

You actually get up.

Yeah, and like in science, we get to move up around.

It's interactive...

You get in circles and you get to tell each other what you learned.

And tell each other different stuff about what they learned.

We have like science talks and get in a group of four and discuss.

You have a partner and everything.

When you're listening, you can hear something you haven't heard before.

And when you're together in a group, you can get help from someone.

If you're an individual, you wouldn't, maybe you wouldn't think of that.

It's inquiractive...

You can ask questions about it.

I keep on wondering what if...

When we're learning we're gonna ask questions.

Well, I, I actually wondered why stars are not in our atmosphere.

When we ask questions we find our information.

Inquiry means to ask questions to someone.

I learn more in an inquiry class. It helps me more.

If we didn't have inquiry we wouldn't have learned what we know now.

I feel good that I could ask questions.

Because there's a lot of questions to ask.

I like inquiry class because you can ask about what you don't understand.

I wonder if we're ever going to figure out if space really does end.

But I have one question...

When does *New Horizons* reach Pluto?

(Compilation of student comments revealing the *active, interactive, and inquiractive* theme, 2010)

Looking Ahead

In Chapter Five, I incorporate the initial themes described in Chapter Two and the newly emerging themes in Chapter Four to capture the essence of **the lived experience of 4th grade students engaged in the process of space science inquiry.**

I, then, seek to articulate the insights gained from this study for teaching about inquiry-based science classrooms for the larger educational community.

CHAPTER FIVE:

PASSION WITH COMPASSION: GIVING SPACE AND FINDING SPACE IN THE INQUIRY-BASED CLASSROOM

The night breaks when the red fire of dawn is kindled and the world glows again in the beauty of colour. Of all colours, red is perhaps the most passionate and intense. Red is never neutral. When red is present, something is happening... It is not a colour that dwells in some secure middle region where rest and stillness prevail. Red is a threshold colour; it tends to accompany and intensify beginnings and endings. (O'Donohue, 2004, p. 97)

What new light of insight has dawned? What lived meaning has been illuminated by the red glow of morning light? As the children's stories are told, what new thresholds have been crossed? The stories do not call us to step back or to close our eyes. The voices do not wish for us to forget or ignore what they have shared. They call for a beginning. They call for passion. They secretly hope for compassion. As we read and re-read the glowing red words expressing children's lived experiences, we are awakened. They call us to accompany them into their lifeworld. They demonstrate a desire to find space. They call us, as educators, to give it.

Helen Keller, lost in a dark, empty place, was given space, shared with all the passion and compassion her teacher could give. Then she awoke to find a new beginning, a world glowing again with the beauty of color and alive with meaning.

Keller describes that moment:

Suddenly I felt a misty consciousness as of something forgotten – a thrill of returning thought; and somehow the mystery of language was revealed to me. I knew then that “w-a-t-e-r” meant the wonderful cool something that was flowing over my hand. That living word awakened my soul, gave it light, hope, joy, set it free! (Keller, 1903/2003, pp. 27-28)

Helen's story describes a threshold where darkness turns to light. Her teacher guides her, yet she must continue to take steps towards the light. In *The Story of My Life* (Keller, 1903/2003), John Macy describes the contributions of Anne Sullivan, Helen's teacher, this way:

What the little pupil has thus far accomplished is widely known, and her wonderful attainments command general admiration; but only those who are familiar with the particulars of the grand achievement know that the credit is largely due to the intelligence, wisdom, sagacity, unremitting perseverance and unbending will of the instructress, who rescued the child from the depths of everlasting night and stillness, and watched over the different phases of her mental and moral development with maternal solicitude and enthusiastic devotion. (p. 136)

Anne Sullivan demonstrated undying passion and compassion for her student. Helen responded with a relentless passion for learning. How does this story inform us? In what ways can we allow this story to illuminate the narrative of the space science classroom? What can we discover from the stories told by conversants engaged in light-giving, life-touching learning? What do we learn from the learners in the inquiry-based space science classroom?

Passion with Compassion

Fourth-grade science was when I first really became immersed or was able to be immersed in learning about space. And there's so much to be learned about space, and so little is known even today, that the possibilities were endless. And so all the questions that I could ask and all the questions that I did ask, there was finally an opportunity for those questions to be answered. And it was extremely inspiring because, being so young and not being able to comprehend just how crazy space is, it was really cool to learn about it for the first time and have teachers who were so passionate about making us be passionate about space, because we had never been involved with it before. (Conversation with Aubrey, April, 2011)

Passion's earliest meaning, from the Latin *pati*, is to suffer. In today's common usage, however, "Passion usually implies a strong emotion that has an overpowering or compelling effect" (*Webster's New World College Dictionary*, 2001, p. 1052). Etymologically, *passion* is closely related to the word *patient*, meaning "bearing or enduring pain, trouble, etc. without complaining or losing self-control" (*Webster's New World College Dictionary*, 2001, p. 1055). Passion is sometimes synonymous with both enthusiasm and zeal. "Zeal implies intense enthusiasm for an object or cause, usually as displayed in vigorous and untiring activity in its support" (*Webster's New World College Dictionary*, 2001, p. 1055). All of the following terms, *passion*, *patient*, *enthusiasm*, and *zeal*, can be descriptive of both student and teacher within the inquiry-based experience. In the quote above, Aubrey passionately describes an enthusiasm for space ignited during her 4th grade experience.

Thinking of the early meaning of *passion*, did Aubrey suffer? Did she endure pain or trouble? Probably not to any great extent. Did the experience require patience? Maybe, but how much is unknown. Aubrey's experience may better be described as one having "an overpowering or compelling effect." I vividly remember Aubrey's zeal as a 4th grader. Her enthusiasm was contagious. I can still picture the intensity of passion demonstrated by Mrs. V to challenge her students and expand their experience-base. Alongside her, I spent the hours of planning and discussion that go into building a transformational experience for children. Someone with such intense passion, whether a student or teacher, is very likely not cognizant of the cost of this kind of passion – the time and effort exerted go unnoticed. They do not view the work as hurtful or agonizing, though, it does cost them something in terms of

time, energy, and effort. While Mrs. V and I put all we had into our efforts, Aubrey would report staying up long into the night pondering the universe and formulating questions. She tells stories of trying to convince her family members to participate in “Samoan Circle” formatted discussions surrounding her questions. Her zeal did not come without a cost, but she loved the process. Mrs. V and I loved it, too! We were passionate about space and science education. In, *A Framework for K-12 Science Education*, the National Research Council states:

A rich science education has the potential to capture students’ sense of wonder about the world and to spark their desire to continue learning about science throughout their lives. (National Research Council, 2011, p. 2-4)

How is a sense of wonder captured? What ignites this passionate desire to continue to learn? In what ways are the lived meanings of learning and wonder brought to life in the inquiry-based classroom?

Passion for Learning

Far too little of what most students do in school engages their imagination, fuels their passion to learn, connects them deeply with the world, or wins their hearts and minds. (Jardine, Clifford, & Friesen, 2003, p. 93)

The inquiry-based classroom is a place of passion! It is a place with “an overpowering and compelling effect.” It is alive, intense, and engaging. Within the experience, participants can be described as passionate, patient, enthusiastic, and even zealous. The inquiry-based classroom is a safe place, yet it challenges each participant to take great emotional risk. At its best, it is a highly desired experience, but never easy. It is a source for answers, but the sort that inevitably leads to more questions. The intensity of the experience makes it compelling. Overarching the space

that transforms into a passionate place for learning, the experience embodies a balance – a rhythm of activity, interactivity, and inquiractivity, intertwined with space. To reveal how such a space is experienced, I continue to seek insight.

Aubrey sheds light, describing her current interests and connects them to her elementary experience:

I'm involved in so many different areas of academic and extracurricular interests that it's like I'm just juggling it all at one time and it's—but I do it because I love it, and I love knowing more, and I love learning. And all this came out of having such passionate teachers, who told us that learning is fun and you can learn without having to be stuck inside a room all day reading out of a book. I mean, I love books, but you don't have to sit there and read ten pages of a textbook just to learn something. I can go out and do things. Or I can ask other people and do all this really cool stuff. And I learned that from fourth-grade science. (Conversation with Aubrey, April, 2011)

Aubrey's testimony is overwhelming. The nature of this work is not to compel the reader with evidence to support a claim, but rather to open a way to share the essential of an experience. Aubrey's experience in the space science classroom helps to reinforce the story the 4th grade conversants already have articulated. The essence of their experience gives us a view of the impact of learning about space, the impact of teachers' passion about space, and the impact of teachers' dedication to giving space in an inquiry classroom.

Paula, the other 11th grade student I had the opportunity to reflect with, also spent time looking back to the 4th grade experiences she had seven years earlier. I asked her, "So here's your chance, if you have anything to say, what would you tell a teacher about—an elementary school teacher—about whatever you wanted to tell them to make their teaching or the experience for their students more impacting?"

Paula replies:

Be like the teacher from *The Magic School Bus* because she is just like my teacher now and she reminds me of you and Ms. V. And just because when someone is so interested in something, it makes me want to get interested in it, no matter what it is. You know. It could be physics. And if you're so excited about it, I'll be excited about it...And if you, you don't treat your kids like they're kids, you don't talk to them, like, don't talk down to them I guess. Like, if you talk to them, like, not scientific language, but higher language that they have to, like, come up to your level instead of, you know, treating them like babies, because they're not. (Conversation with Paula, April, 2011)

Paula, like Aubrey, makes a plea for teacher initiated passion for learning in the elementary inquiry-based classroom! She states, "If you are excited about it, I'll be excited about it." But is this *always* true? Perhaps not! Humans are much too complicated for that kind of automatic response. Yet her experience in the 4th grade space science classroom has made a profound impact on her life. A teacher's zeal has had a profound impression on her life – and continues to influence her today. Aubrey adds this:

Teachers who are excited have students who are excited. I have had several teachers in the past who are boring and they don't like their jobs and they clearly don't want to be there, and that makes me not want to be in the class and it makes me dislike the subject to whatever degree. And then I've had some crazy cool teachers who just love what they do and they know what they do and they get excited...And in fourth grade my teachers were fun and they loved what they did and they made us excited about it, and it's clearly carried on throughout my experience as a student. And I'm sure it will in my college career and whatever I do after college. I actually want to become a teacher myself. (Conversation with Aubrey, April, 2011)

As educators, we must continue to attend to students' voices, rather than dismissing them as "but one viewpoint." We must ask, "What is Paula telling us? What is Aubrey trying to communicate? What do the voices of the 4th graders mean? How can these powerful and articulate voices instruct us as educators? Are they

calling for passion from their teachers? The *Framework* (National Research Council, 2011) adds further insight to comments made by Aubrey and Paula:

Research suggests that personal interest, experience, and enthusiasm—critical to children’s learning of science at school or other settings—may also be linked to later educational and career choices. Thus, in order for students to develop a sustained attraction to science and for them to appreciate the many ways in which it is pertinent to their daily lives, classroom learning experiences in science need to connect with their own interests and experiences. (National Research Council, 2011, p. 2-4)

Within the inquiry-based experience, students are challenged to think, they are motivated by passionate teachers and they grow in their passion for thinking and learning. Aubrey says the inquiry classroom “...was extremely inspiring.” She says passionate teachers “...told us that learning is fun.” She writes, “Now, I can appreciate the passion that my teachers had...and their goal to spread that passion to others.” Aubrey even says, “I actually want to become a teacher myself.” Paula states, “...when someone is interested in something, it makes me want to get interested in it, no matter what it is.” She remarks, “...she [*Mrs. V*] pushed us to think farther into things than we would have...” Such comments reinforce the observation that the development of personal meaning for students in the inquiry-based classroom, influenced by the actions of passionate teachers, impacts their daily lives and potentially steers their career choices.

Compassion for Learners

...pedagogical fitness presumes a sense of vocation, a love and caring for children, a deep sense of responsibility ...a capacity to listen to and “see” children, and a generally trustful, sympathetic attitude toward young people. (van Manen, 1991, pp. 123-124)

Paula goes on to describe an aspect of the classroom experience that moves beyond the realm of passion. She adds, “If you don’t treat your kids like they’re kids...don’t talk down to them, I guess.” She goes on to suggest teachers should use “higher language,” believing that students of all ages have the capacity to think and learn. The *Framework* (National Research Council, 2011) supports Paula’s appeal, stating:

In fact, the capacity of young children—from all backgrounds and socioeconomic levels—to reason in sophisticated ways is much greater than has long been assumed. Although they may lack deep knowledge and extensive experience, they often engage in a wide range of subtle and complex reasoning about the world...By listening to and taking these ideas seriously, educators can build on what children already know and can do. (National Research Council, 2011, pp. 2-1 – 2-2)

Paula’s statement demonstrates recognition of the profound respect imparted to her by her teachers and a desire to see such respect imparted to others. Likewise, the *Framework* (National Research Council, 2011) calls for a recognition of students’ capacity to reason in sophisticated ways, calling educators to listen to and take these ideas seriously. This level of respect is a form of compassion. Compassion’s root word indicates the meaning has a direct connection to *passion*. *Webster’s New World College Dictionary* (2001) defines compassion as, “sorrow for the sufferings or trouble of another or others, accompanied by an urge to help” (p. 297). This definition of compassion is tied to the early meaning of *passion* – to suffer. A more commonly used definition of *passion* is associated with “intense enthusiasm.” The modern usage suggests a need for an alternate description for the term compassion. For example, compassion could also be defined as, “Intense enthusiasm for an object or cause,

accompanied by an urge to help.” Van Manen describes this “urge to help,” directed toward a person, not just an object or cause:

Especially where I meet the other person in his or her weakness vulnerability or innocence, I experience the undeniable presence of loving responsibility: a child who calls upon me may claim me in a way that leaves me no choice. Most parents have experienced this moral claim and many teachers and other educators who are involved in pedagogical relationships in a self-forgetful manner have experienced this effect of children in their lives. When I love a person (a child or adult) I want to know what contributes toward the good of that person. (van Manen, 2003, p. 6)

Teachers’ passion for the best interests of their students becomes compassion as they respond to the moral call to help in some way. An “intense enthusiasm” for student growth and learning triggers an urge to help. Children sense the passion of a teacher and experience the compassion that follows – compassion based upon a drive to help, not necessarily a response to sorrow, suffering, or trouble. To be sure, there are many instances of genuine suffering on the part of students, and caring responses from teachers are commonplace. This kind of compassionate response, in the traditional sense of the word, was not revealed in dialogue with the conversants during this study.

Beyond the enthusiasm of her teachers for the subject matter, Paula experienced a kind of compassion, a zealous enthusiasm, a deep caring, from her teacher for her as an individual and a learner. This level of compassion is highly motivational. The message from the teacher is, “I am excited about you and I care about you because you have the potential to do so much! Do not limit yourself, or hold back in considering what possibilities are out there for you! I believe in you!” Anton (2001) provides a thought provoking insight in this regard:

The passionate responsibility of our being-with-others...enables others to be free for their possibilities. Authentic being-with-others in lived-through world-experience is a passionate responsibility that recognizes that nothing separates me from the other, and so, it works to liberate others in the how of their concern. (p. 158)

The passionate teacher expressing compassion for children offers a setting rich with possibilities. But even a passionate teacher and compassionate teacher, descriptive of so many dedicated elementary educators, may not automatically give children space or allow children to find space in the inquiry-based classroom. How is such space given? How is it found? What is the lived meaning of space in the inquiry-based classroom?

Giving Space and Finding Space

Giving children time to explore their world, ask questions, and pursue those questions that matter to them most lets them know I value their curiosity outside the classroom as well as inside. My job is to continue to nurture their wonder and work to awaken my own. (Miller, 2002, p. 135)

Conversations with students yield a wealth and depth of understanding about the ways in which the classroom is experienced. For all that children did express in hours of conversation, they did not explicitly state their “need for space” any more than they articulated any reaction to the noise and distractions from the construction taking place outside their classroom. Van Manen (2003) says, “The point of phenomenological research is to “borrow” other peoples’ experiences and their reflections on their experiences in order to better be able to come to an understanding of the deeper meaning or significance of an aspect of human experience, in the context of the whole human experience” (p. 62). As a researcher, the quest for lived meaning of space, an abstract concept for nine-year-olds, becomes a curious kind of

challenge. The taken-for-granted nature of space and the reality that “space” is, by some definitions, not something – a void or lack, makes it all the more elusive – a searching in the dark for that which is not there. To discern the lived meaning of the experience of space, different from the whole of the conversants’ human experience, I must, like a scientist, listen, watch, wait, and take careful notice.

When young conversants experience something they enjoy, they point it out in simple, straight-forward terms such as, “It was cool to...I liked...we got to...it was fun when...” During the experience in the space science classroom, they were given an opportunity to ask and wonder, so they responded with a flood of questions. If I had stopped answering all questions suddenly, I expect they would have quickly learned to stop asking so many questions – a kind of silencing through neglect. They would not likely have revolted or pushed back in any way. A return to the status quo would not have yielded any discernable outcry.

Many classroom experiences, along with numerous observations and conversations, reinforce the view that teachers hold a tremendous amount of power to influence the activity of the classroom in dramatic and positive ways. Giving children space is within the power and control of the teacher, limited of course by the constraints of time and other pressures. Even so, teachers have decision-making power within the classroom and students will receive direct benefit when teachers choose to make an effort to give children space. What does such space look like?

Maxine Greene (1988) gives more insight in her work, *The Dialectic of Freedom*:

In the classroom opened to possibility and at once concerned with inquiry, critiques must be developed that uncover what masquerades as neutral frameworks....Teachers, like their students, have to learn to love the questions, as they come to realize that there can be no final

arguments or answers, no final commensurability. And we have been talking about stories that open perspectives on communities grounded in trust, flowering by means of dialogue, kept alive in open spaces where freedom can find a place...inserting in the world by means of projects, embarking on new beginnings, in space they open for themselves. (p. 134)

The inquiry-based classroom, the elementary classroom, or any classroom with teachers and students open to possibility, in love with the idea that learning is about freedom, and committed to a rigorous approach to growth for any and all students, becomes a space where teachers and students can find space for questions, dialogue, and an open space for learning. Space, in essence, allows freedom, for example: freedom within a setting to choose an activity, freedom within a space to move, freedom within a timeframe to dialogue or ask questions of interest to the learner. Abram (1996) helps to capture a sense of the space made available in the inquiry experience:

Space is no longer experienced as a homogeneous void, but reveals itself as this vast and richly textured field in which we are corporeally immersed, this vibrant expanse structured by both a ground and a horizon. It is precisely the ground and the horizon that transform abstract space into space-time. (p. 216)

The space available in the inquiry-based classroom is not a space-less void, but rather a space of vibrant expanse, a space that has context, a space that provides a richly textured place to form memory and meaning. Any action initiated or permitted by the teacher, to provide such a space opens a door for students to find space. The selfish teacher controls the space too tightly, the passionate-compassionate teacher releases control with intentionality. This may read as an either-or proposition – control vs. freedom. Actually, each teacher struggles daily with the need to consider

time and space as a balance between control and freedom. This struggle largely defines the act of teaching and learning in the inquiry-based classroom.

A classroom experience devoted to space does not mean a learning space void of challenge and rigor. Too often the perception of space as “free time” or “open exploration” characterizes the experience as one lacking depth or impact – an experience where no learning takes place. Aubrey recalls her experiences in the 4th grade space science classroom that challenges this view:

Even as a young student, the space science classroom was one of the coolest learning environments I had been in. Most of the science I had learned (or remember learning) previous to fourth grade was about animals or plants, not anything beyond the ground world. As the fourth grade science classroom was the first place I learned about space, I loved it! Mrs. V and Mr. Horne were so enthusiastic about what they taught that it was easy to get into the subjects as well. Now, I can appreciate the passion that my teachers had for it and their goal to spread that passion to their students. They pushed us to explore. (Aubrey, written comments, 2011)

Did we push Aubrey to explore? That is her recollection and perception. Mrs. V and I had a goal to challenge, inspire, and press the students to think beyond the confines of the curriculum, even the limits of their abilities. Such a commitment to rigor needs space – it requires it. During my conversation with Paula, she adds this insight:

I remember thinking in the math and science of Ms. V’s class a lot higher than I did in the other classes. Like, I had to think more. And sometimes I got really frustrated because I didn’t understand what was going on at first, but she pushed us to think farther into things than we would have as fourth graders. I think we were probably thinking like 8th graders as 4th graders. (Conversation with Paula, April, 2011)

Giving children space is not the allotment of free time to do whatever they want to do. The power of the inquiry-based classroom and the depth of thinking and

learning that is accomplished in such experiences is a multifaceted process. It is not an either-or proposition. *A Framework for K-12 Science Education* (National Research Council, 2011) elaborates:

Current research in K-12 science classrooms reveals that earlier debates about such dichotomies as “direct instruction” and “inquiry” are simplistic, even mistaken, as a characterization of science pedagogy. (p. 10-9)

The lived experience within the classroom unveils the rigor of inquiry and the required complexity necessary to challenge students to grow. In Paula’s inquiry-based experience she remembers being treated more like an 8th grader than a 4th grader. She recalls being challenged to think deeply and dig into a subject, rather than being directed by “fill-in-the-blank” thinking. Giving children space means developing and maintaining respect for children as learners driven by a passion to excite them about learning, regardless of the topic, while keeping in mind the delicate balance needed to present a standards-based curriculum with fidelity. Deep thinking that results from direct instruction requires space for comprehension to develop, space for students to formulate thoughtful questions that will lead to deeper understanding, and space for further exploration triggered by the impact of the instruction. A

Framework for Science Education (National Research Council, 2011) goes on to state:

Ultimately, the interactions between teachers and students in individual classrooms are the determining factor in whether students learn science successfully. Thus teachers are the linchpin in any effort to change K-12 science education. (p. 10-9)

Clearly, the teacher’s role is crucial and decisions enacted in the classroom make a profound impact. Notice the quote above is not focused on the actions of the

teacher nor the reaction by the students, but rather, the interactions between teacher and student. Paula says she got frustrated when she “didn’t understand what was going on at first...but she pushed us to think farther.” This recollection of interaction between Paula and Mrs. V from so many years ago is fresh and alive in her memory. It is not a negative message. Space to struggle gave her strength. The experience is significant. She goes on to share more:

I don’t think I was interested in science or math before fourth grade...I remember getting my first competitive notion in that class, because I wanted to know more than other kids. Before that I didn’t really care. I was like, “Oh, that’s school. Let’s just go for the heck of going.” But I really thought science was interesting. Because before that, the way it was taught to us it just didn’t—the same thing with my project—it didn’t make sense to me because it didn’t affect me. And I didn’t know anything about it. But now that I had that class, it definitely stayed with me, obviously, throughout the years. And then I always paid more attention in class, even if I wasn’t as interested. I pushed myself, I guess. It made me care about math because I knew math was with science. (Conversation with Paula, April, 2011)

Paula states, “Because before that I didn’t really care.” What happened in the inquiry-based experience that sparked her to care? What happened during the experience that said to Paula, “This matters! You should care about this!” In order to maintain a pedagogically sensitive mindset we must continue to focus attention on the students’ experiences and their reflections on them in order to gain insight. A statement in the *Framework* (National Research Council, 2011) reflects the lived experience of students as described by Paula and Aubrey:

Students should have opportunities to plan and carry out several different kinds of investigations... At all levels, they should engage in investigations that range from those structured by the teacher—in order to expose an issue or question that they would be unlikely to explore on their own...to those that emerge from students’ own questions. (National Research Council, 2011, p. 3-11)

Giving children space is obviously not confined to the space science classroom, or to a particular grade level. It is not the case that children must reach a particular age before they can be given certain liberties of the mind. When is a child too young or too old to wonder? At what age should we define restrictions or guidelines for the amount or intensity of space that is provided? Human beings, by their essence, want to know. Human beings respond to caring acts. Caring compassion and passion with respect touches human hearts. Students suggest the inquiry-based classroom can be an environment for such acts. They indicate a need for space. What is it like for the classroom teacher to give space?

Permission to Give Children Space

...before you had come into the classroom, I had never really thought, oh okay, let's do this a little differently. I never thought that I should be teaching any differently than the way that I was or the way that was outlined in the guides. It's just another strategy, I guess, for teachers to use to teach. And I don't know if, if you're not exposed to that or looking, shown how to appropriately do it, I don't know whether teachers would normally do that. Just because I don't think they would normally think to do that. For example, before you had come into my classroom last year, I really stuck to the guides. I asked questions, but not to the point that we had done last year with our inquiry-based learning in the different discussions and Samoan circles that we had. And now having exposure to it I'm like, oh well, this would be a really great place to throw in a talk where they really get to delve into some of those concepts. (Mrs. Z, conversation, January, 2011)

Over and over I pose the question, "What is the experience like for the students?" This must remain our focus, or as educators we will drift into theoretical talks that do not address our children's needs and our desired outcomes for growth and success for the students we serve. As van Manen (2003) says, "We gather other people's experiences because they allow us to become more experienced

ourselves...they allow us to be ‘in-formed,’ shaped or enriched by this experience so as to be able to render the full significance of its meaning” (p. 62).

Integral to the experience of the students are the actions and attitudes of the teacher. This study would not be complete without hearing the teacher’s heart revealed in reference to how she interacts with her students in the elementary classroom. Mrs. Z was open to share her perspective and her questions throughout the process. Her comments often shed light on the way in which students experience the 4th grade classroom. In the quote above from one of the conversations I had with Mrs. Z, she reveals her need as a teacher to be exposed to different ideas if she is to develop as an educator. In her case, the opportunity she gave me to open her classroom to a more inquiry-based approach has influenced her thinking and resulted in shaping the kinds of experiences her students had and possibly the experiences future students will live. Just as telling students’ stories may impact future students’ stories, likewise, telling a teacher’s story may impact future teachers’ stories.

As Mrs. Z shares the impact of shifting towards a more inquiry-based approach, she adds this:

Yeah, it’s really incredible because the students come up with such interesting questions that you really, as an adult, don’t really take the time in most cases to stop and think about like, you know, where does light come from? Where did it originally come from? Looking now at clocks and how we tell time and looking back at, well, how did they used to tell time before all of this took place? ...So the space unit is really something that pulls out that inquiry learning because it is such a curious topic for the children because there is so much of the unknown. I do feel like they have been able to go back and really ask those thought-provoking questions and really wonder a lot about the other units as well. Although they aren’t quite, I don’t think, as mysterious as the space unit, they do have a lot of things that they question. And it is amazing to hear the questions that they come up with. (Mrs. Z, conversation, January, 2011)

Reading Mrs. Z's comments and recollections, one cannot help but wonder how her new approach to students' wonderings might impact their learning, their attitudes, even their futures. Essential to our work as educators, Mrs. Z points out that children can direct us to questions that we "don't really take the time, in most cases, to stop and think about." At the core of this work, we must consider the essences brought forth by the ideas students reveal and allow them to inform us about the ways in which we will respond. In *The Sense of Wonder*, originally titled, *Help Your Child to Wonder*, Rachel Carson (1956), famous scientist, author, and conservationist, writes:

A child's world is fresh and new and beautiful, full of wonder and excitement. It is our misfortune that for most of us that clear-eyed vision, that true instinct for what is beautiful and awe-inspiring, is dimmed and even lost before we reach adulthood. (p. 54)

Through their insightful words, both Mrs. Z and Rachel Carson bring a sense of power and urgency to the students' voices that are so easily missed in a field dominated by expert voices and strategies that "work." I do not mean to negate expert voices, nor do I dismiss a need for strategies that work in the elementary classroom; I merely advocate for the proper and powerful placement of student voice as a critical driving force in the success of our noble efforts in education. As educators, what do we value by way of practices in the classroom? What are we looking for from our students and from each other? Mrs. Z reflects on how an administrator might view her inquiry-based classroom practices:

You know, I think if I was being observed by an administrator—they would have to sit in and really be listening to whatever conversations were happening. They would really have to take the time to understand where the conversation is coming from. Why are these questions being

asked? I think at first they might feel like, is this really an effective way to get a point across? But I feel like if the administrator took the time to look back and to really think, okay, this is where it's coming from, I think that they would be okay with it and see that it really was a positive way to arrive at conclusions and make discoveries. (Mrs. Z, conversation, January, 2011)

Would the space being made available to children by the practices of student dialogue and active questioning, reveal itself to an observing administrator? Mrs. Z believes so. The question is situation dependent; yet, it also opens the question of perception about what constitutes sound instructional practices and how the learning space should be structured to encourage learning. In a room alive with space science inquiry, what does an observer see? What does the observer expect to see? The space may reveal student thinking because students are actively conversing. The space may reveal freedom of movement as students are up from their seats, active, manipulating models, or acting out celestial events. The space may appear silent as the teacher allows a thought-provoking question to remain unanswered. How are these behaviors perceived? How does the influence of a school administrator impact teaching and learning in the inquiry-based classroom?

During the school-year following the formal study, Mrs. Z shares insight she has gained over time, contrasting her prior practices with her new ones:

I don't think that I felt quite as comfortable letting the students take hold of—I mean, yes, the rapport was still there. The community was still built. But I don't think I had since the beginning really empowered them with that kind of, those kinds of abilities, those kinds of strategies. So I feel like, I feel like I—I don't want to say I'm a different teacher. But I look at things differently now. I would say that the way that I've built my relationships with my students this year is a little different from how I had done that last year. And now midway through the school year, I feel like my students this year would be a little more capable of making those transitions and being able to

effectively use those strategies than at the middle of the year last year.
(Mrs. Z, conversation, January, 2011)

Mrs. Z is reflective, allowing herself space to consider her own practice and the impact her actions and attitudes might have had. She remains open to possibilities for growth. She allows insight from her students to reshape her thinking. She is willing to articulate her strengths and needs. Mrs. Z exemplifies the teacher who has answered a call. Heard and McDonough (2009) articulate the impact a teacher like Mrs. Z can make:

We need to think about creating primary classroom environments that give children the opportunity for wonder, mystery, and discovery; an environment that speaks to young children's inherent curiosity and innate yearning for exploration is a classroom where children are passionate about learning and love school. (p. 8)

The inquiry-based classroom, such as the place Mrs. Z develops for her students, is a place that speaks to children's inherent curiosity. Children in the inquiry-based classroom are passionate about learning and love school. Individuals in the inquiry-based classroom experience transformation, inspiration, and direction.

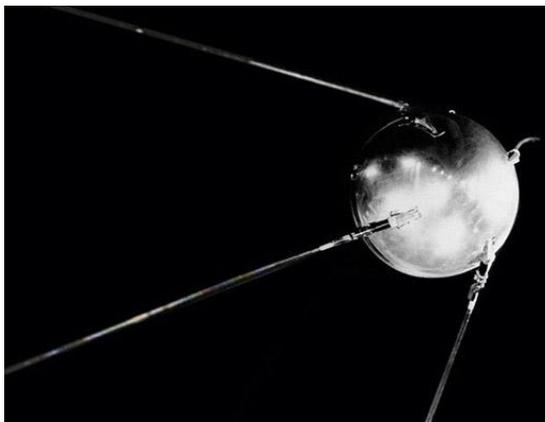
Throughout this study, what students and teachers experiencing the inquiry-based space science classroom have shared with us is possibility. They have uncovered insights of wonder, community, voice, action, interaction, and inquiraction, with an overarching sense of space driven by passion and compassion. It is possible to allow their voices to direct us. As a decision-maker in the field of education, I must let the voices of these children echo continuously in my ear. I must interact with the text of their message. What have they said, in essence? What is the essentiality of their message? What do they call me to do?

The challenge I put forth to readers is to find time and space to interact with the text. Allow the words of the students to speak to your heart as an educator. Let the stories challenge you. Take notice of the illumination that occurs as well as the dark spots that stand in contrast to the light. As you read the text, rich with student language, let it reach out to you and challenge your perspectives and your practices. What does it say to you? How will you respond? What questions do you now have? How will you seek answers to your inquiries?

As a researcher, I wonder if I have given an adequate description of the student experiences. Have I allowed their perspective to shine through? I must continue to reflect, consider the ramifications of the lived meaning of the students' experiences in the inquiry-based classroom, and consider implications for the future.

Sputnik Moment: Accepting the Challenge

When the Soviet Union launched Sputnik a little more than a half century ago, Americans were stunned. The Russians had beaten us to space. And we had to make a choice: We could accept defeat or we could accept the challenge. And as always, we chose to accept the challenge. (Obama, 2009)



(Image 5.1 <http://www.jpl.nasa.gov/explorer/captions/sputnik.php>)

In his state of the union speech on January 25, 2011, President Barak Obama declared: "This is our generation's Sputnik moment." Cassandra Vert (2011) explains the backdrop for the Sputnik reference:

Sputnik was the first piece of hardware sent into space. The Soviets sent it there in 1957, the same Soviets who had in 1956 said "We will bury you." We know now it was an empty threat and not even an accurate translation of what Khrushchev said, but at the time we had no idea what lay behind that iron curtain, and Sputnik only fueled our fears. (*Politicus USA Online* January 26, 2011)

The Sputnik scare led President John F. Kennedy to launch the space race on May 25, 1961, calling for sending an American safely to the moon before the end of the decade. Washington Post staff writers Kornblut and Wilson (2011) put Obama's Sputnik reference into context:

President Obama sought to rouse the nation from complacency in his State of the Union address Tuesday, urging innovation and budget reforms that he said are vital to keep the United States a leader in an increasingly competitive world... "Sustaining the American dream has never been about standing pat," Obama said. "It has required each generation to sacrifice, and struggle, and meet the demands of a new age. Now it's our turn." (*Washington Post Online*, January 26, 2011)

What sacrifices must we make? What struggles will we face? What must we do to prepare for the challenges ahead? What implications are there for the educational community? If it is soon to be "our turn," what are the next steps?

Kornblut and Wilson (2011) go on to state:

Half a century ago, when the Soviets beat us into space with the launch of a satellite called Sputnik, we had no idea how we'd beat them to the moon. The science wasn't even there yet. NASA didn't exist... But after investing in better research and education, we didn't just surpass the Soviets; we unleashed a wave of innovation that created new industries and millions of new jobs. (*Washington Post Online*, January 26, 2011)

Current trends in education call for increases in STEM (Science, Technology, Engineering, and Mathematics) education initiatives. Will STEM initiatives lead us into a prosperous future? Like the wave of jobs created 50 years ago, will the STEM movement spur growth in high tech jobs? Will this movement cause a transformation in science education to the magnitude experienced in the United States during 1960s, with the introduction of innovative elementary science curriculum such as SCIS (Science Curriculum Improvement Study)?

In Maryland, a recently awarded \$250 million dollar *Race to the Top* grant, part of a massive 4.35 billion dollar spending initiative funded through the American Recovery and Reinvestment Act, includes a substantial STEM component, prompting a change in the way in which science is taught in our schools. The *Maryland State Department of Education* website (2011a) states:

President Obama clearly articulated the connection between education and economic growth: “Because we know America can’t out-compete the world tomorrow if our children are being out-educated today, we’re making the largest investment in education in our nation’s history.” (American Recovery and Reinvestment Act)

Maryland’s *Race to the Top* initiative incorporates sweeping change in curriculum standards in English, Language Arts, and Math with the adoption of the Common Core State Standards (CCSS). It also includes a significant STEM education effort which encompasses a 3-year professional development initiative in STEM for representatives from every elementary and middle school in the state of Maryland through Educator Effectiveness Academies. The program was initiated during the summer of 2011. Each Maryland school’s STEM representative is to meet the following criteria:

- are interested in the STEM content areas
 - infuse the use of technology to increase student learning
 - have interest or experience in cross-curricular teaching
 - believe it's important for students to learn through problem-solving/inquiry and project-based learning
 - encourage their students to work in collaborative groups and participate in various STEM challenges
 - would be willing to make a commitment to develop or enhance a positive STEM culture within their school
 - would collaborate with other teachers at their school in developing a STEM professional learning community
- (*Maryland State Department of Education* website, 2011b, Educator Effectiveness Academy Information Sheet)

One of the stated goals of the educator effectiveness academies is to

“Develop an understanding of the relationship between Maryland's vision of STEM and the Maryland Common Core State Curriculum Framework” (*Maryland State Department of Education* website, 2011c, Master Teacher Application). Maryland's vision for STEM education states:

Maryland's vision is to be a leader in STEM education, preparing and inspiring generations of learners to meet the challenges of the global society through innovation, collaboration, and creative problem solving. (*Maryland State Department of Education* website, 2011d, Science, Technology, Engineering, and Mathematics (STEM) Education)

Kennedy's call for action in 1961, less than a week after my birth, profoundly impacted my childhood experiences and developing interests in science and space – and ultimately my career choices. Fifty years later, what impact will the actions of the current administration have on the lives and futures of our citizens and students? How might our students' career choices be impacted by the new challenges set before us? What are the potential benefits and pitfalls of these actions? How will the movement impact our schools, our instruction, our way-of-being in the science classroom? Just as a whole generation of students were impacted by the furor created by the space

race in the 1960s, today's focus on STEM education in Maryland and across the nation, will likely have an overwhelming impact as well. Looking forward, we need to remember to look back, and never forget to look to the present, into the faces of our students.

The conversants in this study have shared their stories, shined their lights, and as a result, opened our eyes. They have allowed us to see how *action*, *interaction*, and *inquiraction* play an essential role in the inquiry-based experience in the elementary space science classroom. How do these themes mesh with the vision for STEM and science education as it is being implemented in the state of Maryland and across the nation? In President Barak Obama's address to the National Academies of Science, April 27, 2009, he declares:

Our progress as a nation – and our values as a nation – are rooted in free and open inquiry. To undermine scientific integrity is to undermine our democracy. It is contrary to our way of life. (Obama, 2009)

Science and STEM education join the wave of change in public education in America. In addition to STEM initiatives beginning in Maryland this summer, a seminal document, *A Framework for K-12 Science Education*, was released on July 19, 2011. This release marks the first significant update in science education standards since the introduction of the *National Science Education Standards* (National Research Council, 1996) 15 years ago. Change is here! Will we accept the challenge? How will we respond to the new standards? How do the changes align with the lived meaning of inquiry described by our conversants? Now I will take a closer look at the new *Framework* (National Research Council, 2011) in anticipation of the release of the next generation of science standards.

The Next Generation of Science Standards

A joint effort between Achieve, the National Science Teachers Association, the American Association for the Advancement of Science, and the National Research Council is underway to create the foundations for all students to have a solid K-12 science education.

Starting in fall 2009, the National Research Council convened an expert panel to lay the groundwork for the development of a Conceptual Framework that will reflect the best thinking on the nature of the science and engineering education that is needed in the 21st century. ...[now that] the final version is released ... Achieve will develop—along with states and other interested stakeholders—next-generation science education standards that are faithful to the NRC Framework, internationally-benchmarked, and rigorous. (*Achieve* website, 2011)

A Framework for K-12 Science Education (National Research Council, 2011), lays the foundation for the next generation of science standards, due to be released by the end of 2012. Maryland will play an integral role in this process. A press release from the *Maryland State Department of Education* (2011) states:

BALTIMORE, MD (September 20, 2011) –Maryland has been selected to help lead a broad-based effort to strengthen science education for all students.

The State is one of 20 states leading the development of what are known as the Next Generation Science Standards (NGSS), which will be designed to clearly define the content and practices that students will need to learn from kindergarten through high school.

Maryland was an early supporter of the new Common Core State Standards initiative, which is bringing stronger K-12 standards in reading/English language arts and mathematics to schools over the next three years. The NGSS work dovetails with Maryland's involvement in the Common Core.

As this important work moves forward, the *Framework* (National Research Council, 2011) will serve as an invaluable guide. The document states:

The overarching goal of our framework for K-12 science education is to ensure that by the end of 12th grade, *all* students have some

appreciation of the beauty and wonder of science; possess sufficient knowledge of science and engineering to engage in public discussions on related issues; are careful consumers of scientific and technological information related to their everyday lives; are able to continue to learn about science outside school; and have the skills to enter careers of their choice, including (but not limited to) careers in science, engineering, and technology. (National Research Council, 2011, p. ES-1)

The *Framework* (National Research Council, 2011) is informative to us as a reference point to place in juxtaposition with student experiences in the inquiry-based classroom. How do the students' stories bring life and meaning to the key components of the framework? How do the themes of *activity*, *interactivity*, and *inquiractivity* provide lived meaning to the *Framework*? What are implications for our students with the introduction of new science standards?

From Inquiry to Practices

We use the term “practices” instead of a term such as “skills” to emphasize that engaging in scientific investigation requires not only skill but also knowledge that is specific to each practice. Similarly, because the term “inquiry,” extensively referred to in previous standards documents, has been interpreted over time in many different ways throughout the science education community, part of our intent in articulating the practices in Dimension 1 is to better specify what is meant by inquiry in science and the range of cognitive, social, and physical practices that it requires. As in all inquiry-based approaches to science teaching, our expectation is that students will themselves engage in the practices and not merely learn about them secondhand. Students cannot comprehend scientific practices, nor fully appreciate the nature of scientific knowledge itself, without directly experiencing those practices for themselves. (National Research Council, 2011, p. 2-5)

The statement above is both informative and promising. The term *inquiry* has been used to imply any number of varying practices in educational circles. As we have examined throughout this study, the *National Science Education Standards* (National Research Council, 1996) uses the word frequently to describe an essential

activity of the science classroom. The new *Framework* (National Research Council, 2011) seeks to describe, more explicitly, the practices of science, making more precise the meaning of inquiry, providing opportunities for children who are “...directly experiencing those practices for themselves” (National Research Council, 2011, p. 2-5).

It is important to consider how future students’ experiences might be impacted by the changing landscape of science education influenced by the next generation of science standards; therefore, I explore each proposed practice in greater depth. The National Research Council (2011) states:

We consider eight practices to be essential elements of the K-12 science and engineering curriculum:

1. Asking questions (for science) and defining problems (for engineering)
 2. Developing and using models
 3. Planning and carrying out investigations
 4. Analyzing and interpreting data
 5. Using mathematics, information and computer technology, and computational thinking
 6. Constructing explanations (for science) and designing solutions (for engineering)
 7. Engaging in argument from evidence
 8. Obtaining, evaluating, and communicating information
- (National Research Council, 2011, pp. 3-5 – 3-6)

Throughout this research project I have sought to articulate the lived meaning of the inquiry experience for children in the space science classroom. The recent introduction of the eight practices, listed above, provides a way to consider the experiences of children in the inquiry-based classroom by examining them through the lens of the new practices. Lingis (2007) offers a cautionary comment:

We may discover that the established discourse about what is important is incomplete or faulty or that the established discourse of

the institution or community covers over practices that deny or betray that to which we have committed ourselves. (p. 123)

As I examine the discourse elaborated in *A Framework for K-12 Science Education* (National Research Council, 2011), I must keep my attention closely fixed to the lived meaning for children, always considering how they might experience the described practices in the elementary classroom. The conversants in this study have revealed essential meanings for various aspects of the inquiry experience, so I seek to maintain a focus on the ways in which the students have enlightened me as I consider each of the eight practices found in the language of the *Framework* (National Research Council, 2011) document.

1) Asking Questions

Students at any grade level should be able to ask questions of each other about the texts they read, the features of the phenomena they observe, and conclusions they draw from their models or scientific investigations. . . . As they progress across the grades, their questions should become more relevant, focused, and sophisticated. Facilitating such evolution will require a classroom culture that respects and values good questions, that offers students the opportunities to refine their questions and questioning strategies, and that incorporates the teaching of effective questioning strategies across all grade levels. (National Research Council, 2011, p. 3-7)

The conversants' experiences were rich with this kind of inquiry. Observers would see students asking questions of one another and to others, demonstrating a "...culture that respects and values good questions, that offers students the opportunities to refine questions and questioning strategies" (National Research Council, 2011, p. 3-7). As Roy reminds us, "When we're learning we're gonna ask questions..." (Conversation 1, March 29, 2010). The practice of "asking questions" is

an essential element of the inquiry-based classroom experience and is properly situated as the first of eight practices. On the topic of asking questions, Mrs. Z states:

Being able to just ask question upon question upon question, I mean, space just has so many never-ending questions. And I think that next year, having the opportunity to do this again, it would be great to be able to encourage children to just continue to ask those questions. (Conversation with Mrs. Z, June 8, 2010)

Practice 1 encourages students to "...ask questions of each other..." (National Research Council, 2011, p. 3-7), just as Mrs. Z intends to continue to practice with her students. Ann Sullivan offers additional support for the essentiality and priority of an open atmosphere for questions. She writes:

It's a great mistake, I think, to put children off with falsehoods and nonsense, when their growing powers of observation and discrimination excite in them a desire to know about things. From the beginning, I have made it a practice to answer all Helen's questions to the best of my ability in a way intelligible to her, and at the same time truthfully. (Keller, 1903/2003, p. 166)

The learning experience for conversants in the science classroom mirror Helen's experience that opened the world of learning to her. Their lived experience was rich with questions, alive with inquiractivity. Practice 1 supports such a climate.

2) Developing and Using Models

Modeling can begin in the earliest grades, with students' models progressing from concrete "pictures" and/or physical scale models (e.g., a toy car) to more abstract representations of relevant relationships in later grades, such as a diagram representing forces on a particular object in a system. Students should be asked to use diagrams, maps, and other abstract models as tools that enable them to elaborate on their own ideas or findings and present them to others (National Research Council, 2011, p. 3-9)

Conversants in the space science classroom gained a greater depth of understanding through the use of physical models. As Jacquelyn reminds us, “You passed out these cool balls to pretend like they’re moons” (Jacquelyn, Conversation 1, March 29, 2010). Experiences with light bulbs, planet models, and moon models were commonplace for the conversants. Jacob comments:

I think a couple of stuff is confusing like how does the planets rotate and revolve. And I think it’s fun when you do the experiments with the light bulb and the Styrofoam. (Conversation 3, March 30, 2010)

The children in the space science classroom were *active* and *interactive* as they frequently engaged in the practice of using models as a means of clarifying their understandings of space science concepts. Practice 2 states how the use of models, “...enable them to elaborate on their own ideas or findings and present them to others” (National Research Council, 2011, p. 3-9). Students in the space science classroom benefited from such experiences.

3) Planning and Carrying Out Investigations

Students need opportunities to design investigations so that they may learn the importance of such decisions as what to measure, what to keep constant, and how to select or construct data collection instruments that are appropriate to the needs of the inquiry. They also need experiences that help them recognize that the laboratory is not the sole domain for legitimate scientific inquiry and that, for many scientists (e.g., earth scientists, ethologists, ecologists), the “laboratory” is the natural world where experiments are conducted and data are collected in the field. (National Research Council, 2011, p. 3-10)

The interactive nature of the experience for the conversants reflects the scientific practice described above. Unfortunately, comments from students too often revealed that while investigations (sometimes referred to as experiments) are routine in the space science classroom, they are not so common in other parts of their school

learning experience. Drew states, “In social studies and math you just use your head and write stuff on paper, but in science you get to do stuff and experience it and like learn new things that you might not know” (Conversation 1, March 29, 2010).

As practice 3 states, it is critical that students have opportunities to engage in the activity of science, recognizing that science learning can and should take place in “...the natural world where experiments are conducted and data are collected in the field” (National Research Council, 2011, p. 3-10). In one of Ann Sullivan’s reports, she notes:

We went out to the pump-house, and I made Helen hold her mug under the spout while I pumped. As the cold water gushed forth, filling the mug, I spelled “w-a-t-e-r” in Helen’s free hand. The word coming so close upon the sensation of cold water rushing over her hand seemed to startle her. She dropped the mug and stood as one transfixed. A new light came into her face. (Keller, 1903/2003, p. 150)

Helen’s “hands-on” experience literally transformed her life. Practice 3 encourages an active, interactive, hands-on experience in science. As our conversants have experienced, it is an essential element of the inquiry-based space science class.

4) Analyzing and Interpreting Data

At the elementary level, students need support to recognize the need to record observations—whether in drawings, words, or numbers—and to share them with others. As they engage in scientific inquiry more deeply, they should begin to collect categorical or numerical data for presentation in forms that help interpretation, such as tables and graphs. When feasible, computers and other digital tools should be introduced as a means of enabling this practice. (National Research Council, 2011, p. 3-12)

Though conversants were given opportunities to conduct data collection, such as making observations of the moon over time and recording and reporting data about

the relative size of the planets, little emphasis was reflected on this aspect of the experience in our conversations. Hammer and van Zee (2006) offer insight:

Don't think either that it isn't scientific to reason in the absence of formal data. No competent scientists simply launch into experimentation. By the time they are actually taking data, they've spent a great deal of time discussing their ideas and expectations for what might happen, including for what data are worth collecting. (p. 170)

In the space science classroom I was purposeful in developing understanding about celestial events, such as the changing phases of the moon phases, and subsequently collecting and considering data. Practice 4 emphasizes the need for students to "...record observations... and to share them with others" (National Research Council, 2011, p. 3-12). This practice supports a classroom atmosphere that is active, interactive, and inquirative.

5) Using Mathematics, Information and Computer Technology, and Computational Thinking

Increasing student familiarity with the role of mathematics in science is central to developing a deeper understanding of how science works.... Students should gain experience in using computers to record measurements taken with computer-connected probes or instruments, thereby recognizing how this process allows multiple measurements to be made rapidly and recurrently. ...Students should thus be encouraged to explore the use of computers for data analysis, using simple data sets, at an early age. (National Research Council, 2011, p. 3-14)

Mathematics is inexplicably tied to scientific thinking. In the space sciences, use of speeds, distances, relationships, and scale are essential in developing an increasingly sophisticated sense of the universe in which we live. The conversants experience the space science classroom without noticing or questioning the obvious integration of subject matter. Thinking of subject areas as isolated and separated

from one another and from a child's everyday life can have a detrimental impact on the ways in which children experience the world of school.

Beyond the obvious relationships between math and science knowledge, Practice 5 challenges us to consider the use of computers and computer programs in scientific pursuits. The conversants made use of computer technologies in their research and reporting, but not as a tool to assist in recording or reporting data.

Practice 5 advocates the use of computers as tools in the science classroom, stating:

As students progress in their understanding of mathematics and computation, at every level the science classroom should be a place where these tools are progressively exploited. (National Research Council, 2011, p. 3-14)

The recommended use of specific 21st century tools (i.e. computer-connected probes) in the science classroom should be reconsidered, as it should be, perhaps, an expectation rather than a stated practice. Scientific thinking in the inquiry-based classroom is not reliant on computers any more than it is reliant on overhead lights in the classroom – but they go a long way in making the learning environment more conducive to discovery. The question is not whether cutting edge tools should be used – of course they should. My challenge is to extend the meaningful impact of the practices by eliminating references to specific tools that will almost certainly seem dated in a few years.

6) Constructing Explanations

Asking students to demonstrate their own understanding of the implications of a scientific idea by developing their own explanations of phenomena, whether based on observations they have made or models they have developed, engages them in an essential part of the process by which conceptual change can occur. (National Research Council, 2011, p. 3-16)

The space science classroom experience provided numerous opportunities for children to learn through hands-on experiences, share their understanding, and challenge their peers with insightful questions and alternative views. Each of these activities of the science class aligns with Practice 6. Describing the space science classroom experience, Drew states:

...you're in a group and you talk in situations that are really about science and space and what other people don't know. And you get a chance to learn about different things in the world and not just like experiments and other science stuff. (Conversation 7, April 15, 2010)

Children in the inquiry-based classroom express value in having opportunities to work in groups and discuss their thinking. Practice 5 describes this as "...developing their own explanations of phenomena" (National Research Council, 2011, p. 3-16).

This practice is further elaborated in the *Framework* (National Research Council, 2011) document:

And explanations are especially valuable for the classroom because of, rather than in spite of, the fact that there often are competing explanations offered for the same phenomenon. (p. 3-16)

The practice of sharing and thinking critically about another's idea is clearly supported here. Hammer and van Zee (2006) elaborate on this practice:

...children draw conclusions from their investigations and present their findings to others...Of course, in many cases children won't be able to account for their results. That's OK; that's part of authentic science. But they should try! Maybe they can't explain their results, but they can rule out an explanation – that would be wonderful! (p. 173)

A theme of child-honoring scientific collaboration is supported thus far by the scientific practices. A child's voice on scientific matters is seen as an essential element of the inquiry-based classroom experience. As the *Framework* (National

Research Council, 2011) indicates, children should be given time and space to interact with materials, with ideas, and with one another.

7) Engaging in Argument from Evidence

Constructing and critiquing arguments are both a core process of science and one that supports science education, as research suggests that interaction with others is the most cognitively effective way of learning. (National Research Council, 2011, p. 3-19)

The notion of science instruction as merely a presentation of “hard facts” is becoming obsolete. “Argument” stands in contrast to a practice of direct instruction. Even a classroom pedagogy focused primarily on direct instruction must at some point allow for the ideas presented to come under scrutiny and questioning from the students. Barnes (1992) states:

If he has a teacher he will learn by open confrontation with the teacher’s life world; each will learn from trying to represent the other’s style of understanding. But this will only happen if both the teacher’s and learner’s purposes are engaged; the alternative is a ritual transmission and assessment directed towards examinations and not towards action. (p. 106)

Practice 7 calls for both action and interaction, stating “...interaction with others is the most cognitively effective way of learning” (National Research Council, 2011, p. 3-19). The conversants agree. Jacquelyn comments:

... because, I mean, it’s easier because you ask—you answer questions, and you have a lot of people to, you know, back you up. (Conversation 14, June 10, 2010)

Students in the inquiry-based space science class grow to rely on one another as a supportive network, backing up one another’s claims and respectfully challenging each others’ ideas, especially with those with whom they disagree. There is a call in

Practice 7 for this kind of practice, a classroom experience far more engaging than one dominated by the transmission of facts.

8) Obtaining, Evaluating, and Communicating Information

From the very start of their science education, students should be asked to engage in the communication of science, especially regarding the investigations they are conducting and the observations they are making. Careful description of observations and clear statement of ideas, with the ability to both refine a statement in response to questions and to ask questions of others to achieve clarification of what is being said... (National Research Council, 2011, p. 3-21)

Communication is an essential aspect of the inquiry-based science experience. Practice 8 encourages communication and values questioning, stating, "...to ask questions of others to achieve clarification of what is being said" (National Research Council, 2011, p. 3-21). Hammer and van Zee (2006) further articulate the value of this practice. They state:

Children love to talk, as any parent knows, especially when they think someone is listening, and taking them seriously. They get excited, even passionate, about expressing themselves. Of course, science curricula should include hands-on activities. Just don't think that's the only or always the best way to engage children in a topic. (p. 170)

The inquiry-based science class as articulated in Practice 8 is a place for questions, a place for students to express themselves, a place for communicating scientific thought and then talking about it. Taking a wider view, how do the practices presented by the National Research Council align with the notion of the inquiry-based experience shared by the conversants?

Reflecting on the Practices

...Our view is that this perspective is an improvement over previous approaches, in several ways. First, it minimizes the tendency to reduce scientific practice to a single set of procedures, such as identifying and controlling variables, classifying entities, and identifying sources of

error...Second, a focus on practices (in the plural) avoids the mistaken impression that there is one distinctive approach common to all science—a single “scientific method.” (National Research Council, 2011, p. 3-2)

Surveying the practices, it is clear that the science class of the future is envisioned to be a shared, interactive, inquirative experience. As one considers each practice individually, questions arise about the expected use of the practices. Certainly they are not intended to become a kind of checklist to be used to guarantee an inquiry-based experience, nor are they to be delegated to the background, yielding to the transmission of factual content information as has been a common practice during this era of No Child Left Behind.

The practices are perhaps better considered with a more holistic view, using them as guidelines for inquiry, with some carrying greater weight or emphasis than others depending on the particular topic being uncovered. The ongoing debate will arise as to how to best balance content with practice in the science classroom. The *Framework* (National Research Council, 2011) states:

From its inception, one of the principal goals of science education has been to cultivate students’ scientific habits of mind, develop their capability to engage in scientific inquiry, and teach them how to reason in a scientific context. There has always been a tension, however, between the emphasis that should be placed on developing knowledge of the content of science and the emphasis placed on scientific practices. A narrow focus on content alone has the unfortunate consequence of leaving students with naive conceptions of the nature of scientific inquiry and the impression that science is simply a body of isolated facts. (p. 3-1)

Indeed, science is not a collection of isolated facts. Which space science concepts have been identified as essential for the next generation of students in the space science classroom? Should there be or are there disagreements about these

concepts? A closer look at the *Framework* (National Research Council, 2011) will help to clarify.

What About the Next Generation of Space Science Content?

The continuing expansion of scientific knowledge makes it impossible to teach all the ideas related to a given discipline in exhaustive detail during the K-12 years. But given the cornucopia of information available today virtually at a touch—people live, after all, in an information age—an important role of science education is not to teach “all the facts” but rather to prepare students with sufficient core knowledge so that they can later acquire additional information on their own. (National Research Council, 2011, p. 2-6)

The *Framework* (National Research Council, 2011) describes the changing emphases on content and practices as we move into a new era in science education. Within the domain, “Earth and Space Science,” there is one overarching core idea: *Earth’s Place in the Universe*. The focus question for this big idea is, *What is the universe, and what is Earth’s place in it?*

Within the domain of Earth and Space Science, there are just two key concepts that focus on space: *The Universe and Its Stars* and *Earth and Solar System*.

The rationale for such a limited scope of content is explained:

...our effort to identify a *small* number of core ideas may disappoint some scientists and educators who find little or nothing of their favorite science topics included in the framework. But the committee is convinced that by building a strong base of core knowledge and competencies, understood in sufficient depth to be used, students will leave school better grounded in scientific knowledge and practices—and with greater interest in further learning in science—than when instruction “covers” multiple disconnected pieces of information that are memorized and soon forgotten once the test is over. (National Research Council, 2011, p. 2-7)

Under the heading, *The Universe and Its Stars*, the following guidelines are provided:

The Universe and Its Stars

What is the universe, and what goes on in stars?

By the end of grade 2. Patterns of the motion of the sun, moon, and stars in the sky can be observed, described, and predicted. At night one can see the light coming from many stars with the naked eye, but telescopes make it possible to see many more and to observe them and the moon and planets in greater detail.

By the end of grade 5. The sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their size and distance from Earth. (National Research Council, 2011, p. 7-3)

The other Earth and Space science concept included in the *Framework* (National Research Council, 2011), *Earth and Solar System*, provides the following guidelines:

Earth and the Solar System

What are the predictable patterns caused by Earth's movement in the solar system?

By the end of grade 2. Seasonal patterns of sunrise and sunset can be observed, described, and predicted.

By the end of grade 5. The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily and seasonal changes in the length and direction of shadows; phases of the moon; and different positions of the sun, moon, and stars at different times of the day, month, and year.

Some objects in the solar system can be seen with the naked eye. Planets in the night sky change positions and are not always visible from Earth as they orbit the sun. Stars appear in patterns called constellations, which can be used for navigation and appear to move together across the sky because of Earth's rotation. (National Research Council, 2011, p. 7-4)

Many educators will rejoice over the apparent limited scope of content presented here. Others will be deeply disappointed by elimination of concepts that have “always” been taught and for which favorite lessons have been delivered for

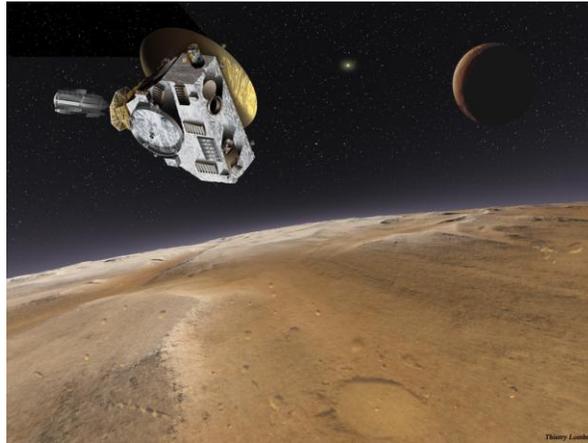
many years. I use the conversants' space science experience as a filter through which to consider the shift in content. I ask, "How would the students in Mrs. Z's class respond to the proposed set of space science concepts? How would the proposed content standards influence their understanding or impact their experience?"

Allowing students adequate time and space to consider the content listed and develop their scientific understanding of these concepts is certain to extend past the scope of time available in the designated allotment for science instruction. In other words, from one perspective, the future of space science learning looks bright, especially in light of the intended structure. A concern, however, is an approach that would use the limited content standards as a checklist of facts to be "taught" without balancing the focused content with the new practices. The *Framework* (National Research Council, 2011) elaborates on the rationale behind the format of the core content:

Each core idea and its component are introduced with a question designed to show some aspect of the world that this idea helps to explain. The question is followed by a description of the understanding about the idea that should be developed by the end of high school. This structure is intended to stress that posing questions about the world and seeking to answer them is fundamental to doing science. (p. 2-6)

In light of the core content proposed by the National Research Council and the framework that has been created, there is reason to embrace hope for a positive impact on science education. Although there are many questions to be answered and details to be considered, there are also reasons to celebrate. As the NRC states in the quote above, "...posing questions about the world and seeking to answer them is fundamental to doing science" (National Research Council, 2011, p. 2-6). These fundamentals are at the heart of inquiry-based learning.

New Horizons: What Does the Future Hold?



(Image 5.2 <http://nssdc.gsfc.nasa.gov/nmc/spacecraftDisplay.do?id=2006-001A>)

Pluto is so small and so far away that even today, the most detailed portraits obtained with the Hubble Space Telescope reveal merely a bleary sphere in shades of grey, as unsatisfying and lacking in detail as a faked photo of a UFO. (Sobel, 1995, p. 212)

The statement above, from Sobel's 1995 book, *The Planets*, is no longer accurate. Recent Hubble Space Telescope (HST) images offer improved clarity and give us true color images of the brown icy planet. Even today, though, images are still fuzzy, lacking much detail. During the timeframe of release of *The Planets* and the *National Science Education Standards* in the mid-1990s, Pluto was thought to have but one moon, Charon. Today, four moons of Pluto have been discovered, the most recent discovery was made at the end of June, 2011. An article on the *NASA Science News* website (2011), entitled: *Hubble Discovers a New Moon Around Pluto* reports:

July 20, 2011

Astronomers using the Hubble Space Telescope have discovered a fourth moon orbiting the icy dwarf planet Pluto. The tiny, new satellite – temporarily designated P4 – popped up in a Hubble survey searching for rings around the dwarf planet.

The new moon is the smallest discovered around Pluto. It has an estimated diameter of 8 to 21 miles (13 to 34 km). By comparison, Charon, Pluto's largest moon, is 648 miles (1,043 km) across, and the

other moons, Nix and Hydra, are in the range of 20 to 70 miles in diameter (32 to 113 km).

The new moon is located between the orbits of Nix and Hydra, which Hubble discovered in 2005. Charon was discovered in 1978 at the U.S. Naval Observatory and first resolved using Hubble in 1990 as a separate body from Pluto. (*NASA Science News* website, 2011)

In the space sciences, developments in understanding are constantly occurring. New discoveries are commonplace. Science standards written “many moons ago” (Pluto’s moons, that is) are being replaced with a new set of standards. The *Framework* (National Research Council, 2011) document sets the stage, with the next generation of science standards just beyond the horizon.

While sweeping changes are exciting the science education world, NASA’s *New Horizons* mission, scheduled to fly by Pluto in 2015, is also bringing new energy to the space science community. The mission has already yielded many interesting discoveries and promises to provide us with even greater insight as well as clear close-up images of the mysterious and distant world. NASA states:

New Horizons remains healthy and on course, now approximately 21 times as far from the Sun as the Earth is – well on its way, between the orbits of Uranus and Neptune. (*New Horizons: NASA’s Pluto-Kuiper Belt Mission* website, 2011a)

Oblivious to approaching changes in educational standards, students in the space science classroom, intrigued by news of the *New Horizons* mission, show unrelenting fascination with Pluto. They want to know. They inquire. They search for information. While “facts” about Pluto are far from static, the books students typically gather from the libraries and school media centers for their planet reports, especially those studying Pluto, are often outdated. In today’s world of technology, it is unfortunate students rely on such sources. Nevertheless, students, animated with questions about the mysteries of the cosmos, show unyielding interest in news from

beyond our world, no matter how they receive the information. Here's a snippet from one of many conversations revolving around the topic of Pluto:

- Mr. Horne: And then we say, well Pluto's not a planet, it's a dwarf planet. Does that make you say, okay, thank you for the information, or does it make you ask some more questions?
- Jacquelyn: Ask some more questions
- Cherry: I have a question. Why isn't Pluto a planet?
(Conversation 1, March 29, 2010)

They pose thoughtful questions, formulated from their deep desire to know.

When an answer is provided, they ask more questions. The inquiries keep coming.

What is it about Pluto that elicits so much curiosity? I inform them that it used to be a planet, and now it is a dwarf planet. They respond, "Why? What happened to it?

Where did it go? Who decides on what's a planet? What's wrong with Pluto? Pluto – that's Messed up, Right?" Sobel offers a rationale for the fascination with Pluto:

People love Pluto. Children identify with its smallness. Adults relate to its inadequacy, its marginal existence as a misfit. Anyone accustomed to a quota of nine planets—anyone averse to changes in the status quo—bulks at disqualifying Pluto on a technicality. (Sobel, 1995, pp. 214-215)

What does this fascination with such a distant celestial object tell us? How does it inform us about the nature of knowledge gained in elementary school (Remember the saying created to remember the nine planets: My Very Excellent Mother Just Served Us Nine Pizzas)? What is the meaning of holding onto the status quo? How will the new scientific practices impact student learning in the future science classroom? What impact will we experience with the change in science content focus? How should we prepare? What does the future hold? Like the students in the space science

class, the inquiries can be endless. Now it is our turn, as educators to become active, interactive, and inquirative in our pursuit of understanding.

Carrying the Message Forward

Mercury, the fastest-moving planet, was named after the Greek god Hermes, the messenger of the gods. He wore winged sandals and a broad brimmed hat, which was also winged to help speed him on his errands. (Burke, 1996, p. 6)

Like Hermes, I deliver a message, first delivered to me by young students, and now being carried forward to you. The message is phenomenological in nature, so it carries the weight of attempting to express lived meaning. Van Manen elaborates:

One may feel that writing, writing that truly addresses the meaning of something, is an entitled endeavor that can only be claimed by the professional philosopher, a great novelist, or poet. But if the goal of writing is to touch something in order to be touched by it then this is no privileged pursuit. (van Manen, 2003, p. 245)

It is the goal of this work, then, to allow the voices of children to first touch me in such a way that I might be touched by it, and then bring the message forward. The work is also hermeneutic in nature. Moran elaborates, “In Greek mythology, Hermes was a messenger of the gods, a go-between between gods and humans, who tells lies as well as truths, who misleads as well as leads...Similarly, Aristotle’s work *Peri Hermeneias (On Interpretation)* concerns the ways in which sentences or statements can be understood. Hermeneutics, then, is the traditional name for the art of interpretation” (Moran, p. 271).

As educators, moving forward in a changing educational landscape, I hope you are challenged to seek interpretation of this text, derive meaning from it, and grow in your perspective. O’Donohue (2008) says, “There can be no growth if we do not remain open and vulnerable to what is new and different. I have never seen

anyone take a risk for growth that was not rewarded a thousand times over” (p. 2). As you draw from the text of these student experiences and reflections, I hope you will take a risk, allowing yourself to be vulnerable to their message. I hope you will take the time to interact with them, interactively inquiract with them, and allow them space in your professional life to influence your thinking.

Aoki (1987) provides inspiration as we move forward:

... a truly educated person speaks and acts from a deep sense of humility, conscious of the limits set by human finitude and mortality, acknowledging the grace by which educator and educated are allowed to dwell in the present that embraces past experiences but is open to possibilities yet to be. Thus, to be educated is to be ever open to the call of what is to be deeply human, and heeding the call to walk with others in life’s ventures. (Aoki, 1987, p. 365)

The conversants have invited us into their lived worlds in the context of the space science classroom. Their contribution is a gift. How will we respond?

To Boldly Go

Space: the final frontier. These are the voyages of the starship *Enterprise*. Her ongoing mission: to explore strange new worlds, to seek out new life forms and new civilizations, to boldly go where no one has gone before. (*Star Trek*, 2009)

The students in the inquiry-based space science classroom have left me permanently changed. They have created within me an unavoidable glow. It is because of their influence, their words, and their emotional response to the space science classroom that I have such a strong and abiding desire to share their message with other educators and to apply it to my own sphere of influence in the field of elementary education. Van Manen (2003) writes,

Phenomenological text succeeds when it lets us see that which shines through, that which tends to hide itself... The words are not the thing. And yet it is to our words, language, that we must apply all our

phenomenological skill and talents, because it is in and through words that the shining through (the invisible) becomes visible. (p. 130)

As I interact with the text, what do I hear? What becomes suddenly visible?

How do the words speak to my future? What meaning do I take with me to the next group of students I encounter? As I reflect, I hear: Allow students time to formulate opinions and share their thinking. Do not “look down” on anyone. Seek to understand each person’s place in the classroom, seeing them as a member of a community, a valued voice, a future leader. Understand your place in the classroom as a leader, a guide, a listener, a teacher, and a learner. Give with caring. Respect all. Remain passionate. Provide compassion. Stay humble – but go boldly. Give children space!

To Boldly Go

We race to the future – undiscovered country.

We give our passion and compassion.

We embrace the many questions.

We allow ourselves to care.

We respect the learners.

We offer space.

We grow.

Go...

(Horne, 2011, reflective writing)

Going

In 1968, a year defined by loss and conflict and tumult, Apollo 8 carried into space the first human beings ever to slip beyond Earth's gravity, and the ship would circle the moon 10 times before returning home. But on its fourth orbit, the capsule rotated and for the first time Earth became visible through the windows.

Bill Anders, one of the astronauts aboard Apollo 8, scrambled for a camera, and he took a photo that showed the Earth coming up over the moon's horizon. It was the first ever taken from so distant a vantage point, and it soon became known as "Earthrise."

Anders would say that the moment forever changed him, to see our world – this pale blue sphere – without borders, without divisions, at once so tranquil and beautiful and alone.

"We came all this way to explore the moon," he said, "and the most important thing is that we discovered the Earth."

Yes, scientific innovation offers us a chance to achieve prosperity. It has offered us benefits that have improved our health and our lives – improvements we take too easily for granted. But it gives us something more. At root, science forces us to reckon with the truth as best as we can ascertain it.

And some truths fill us with awe. Others force us to question long-held views. Science can't answer every question, and indeed, it seems at times the more we plumb the mysteries of the physical world, the more humble we must be. Science cannot supplant our ethics or our values, our principles or our faith. But science can inform those things and help put those values – these moral sentiments, that faith – can put those things to work – to feed a child, or to heal the sick, to be good stewards of this Earth. (Obama, 2009)

In his speech to the National Academy of Sciences on April 27, 2009, President Obama offers a tremendous and awe inspiring challenge. He asks us to consider our long-held views. He reminds us to be humble. He frames the importance of science in light of greater issues of ethics and values. In the context of this study, as fellow educators we head to the future, inquiractively, with many more questions than answers, with a mindset to do something with the moral and ethical questions that are so crucial to the future of the world in which we live.

As we go forward into the undiscovered country that is the future, new inquiries arise. We may ask: What is the meaning of STEM for the 21st century classroom? How can we expand the reach of STEM education past the privileged? In what ways can the lived meaning of STEM be articulated? What moral and ethical issues challenge us as the educational landscape of our schools is being redefined? What role do we play, as educators, in addressing the critical issues of our time? How do the voices of students from the inquiry-based classroom direct us as we go boldly?

Astronaut William Anders looked out of the Apollo 8 spacecraft window on December 24, 1968, and saw earth. What he photographed was transformational both to self and many millions of people as a view of our world without borders was first seen. The photograph, considered by many to be the most influential environmental picture ever taken, offered the world a view of the world that brought new meaning to Being in the world.



(Image 5.3 http://www.nasa.gov/multimedia/imagegallery/image_feature_102.html)

The inquiry-based science classroom, too, can serve as a window from which to consider the world, a vantage point from which to search for answers that will lead to many more questions. As we, collectively, students and teachers, children and adults, progress into an era of change in education, with the next generation of science standards just over the horizon, it is our challenge to wonder and never stop wondering, to inquire, to accept new global challenges, to challenge old ideas, and to wrestle with our essential questions. We are 7 billion people together on one planet, with a desire to know and with a need for space.

APPENDIX A

Name _____

What do you wonder about space? I wonder...

APPENDIX A (CONTINUED)

Mrs. V's class, September 4, 2003

I wonder...

- Are there really aliens on other planets?
- Has any astronaut been to any of Mars' moons?
- Is there life in space?
- Is there another planet out there next to Pluto?
- How does a meteor shower happen?
- How many years does it take to get to Pluto?
- How long does it take the entire solar system to travel around the sun?
- How was science started?
- How bright is the sun?
- How long does it take to get to Mars?
- What if we discovered a new planet with life on it?
- Can we inhabit Mars?
- How do the stars transform into things like the Big Dipper and the Little Dipper?
- How can people find new planets in space?
- How come planets with rings have them?
- If time travel is real, is there really a parallel universe?
- Is there life on any other planets in this galaxy?
- Why isn't there gravity on other planets?
- Why don't the planets just fall out of space?
- Why does Uranus have a black ring?
- How long does it take to get to another planet in the solar system?
- How many stars are in the sky?
- Why isn't there any oxygen in space?
- Why do we need oxygen?
- I wonder if scientists will find a new planet.
- If we are going to move to Mars because Earth is going to come apart.
- I wonder why I wonder.
- Has any ship been sucked by a black hole?

APPENDIX B

Time Management Guide
Space Grade 4
20 days

Section : Investigation	Day	Time Needed	Indicator	Assessment Question
Introduction to Science Processes	Day 1	40 minutes	Refer to "What Do Scientists Do?" Poster I Wonder.... Activity	Ongoing, teacher should connect the processes throughout the unit as they teach the daily lessons.
1:1 Day and Night: Why Does Earth Have Day and Night? Page 5 TG	Day 2	40 minutes	Recognize and describe that the rotation of planet Earth produces observable effects •The day and night cycle •The apparent movement of the sun, moon, planets, and stars 5-2.D.2.b Describe the rotation of the planet Earth on its axis. 5-2.D.2.a Recognize that like all planets and stars, the Earth is spherical in shape. 5-2.D.1.a	During the day the sun appears to move across the sky. In the night time sky the stars, moon and even other planets appear to move across the sky. Explain why.
2:1 The Moon Revolves Around the Earth: What Causes Moon Phases? Page 14 TG	Day 3	40 minutes	Recognize and describe the causes of the repeating patterns of celestial events. 5-2.D.2 Verify with models and cite evidence that the moon's apparent shape and position change. 5-2.D.2.e	The repeating pattern of the moon phases is a celestial event. Describe the cause of this celestial event. In your answer be sure to include: •Where does the moon gets it light? •What causes moon phases?
2:2 The Moon Revolves Around the Earth: We Always See the Same Side Page 17 TG	Day 4	40 minutes	Identify and describe the variety of objects in the universe through first hand observations using the unaided eye, binoculars or telescope or videos and/or pictures from reliable sources. 4-2.D.1 Identify and compare properties, location, and movement of celestial objects in our solar system. 5-2.D.1	Compare the moon's rotation and revolution and explain the significance of this movement.

APPENDIX B (CONTINUED)

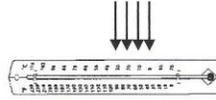
Time Management Guide
Space Grade 4
20 days

Section : Investigation	Day	Time Needed	Indicator	Assessment Question
3:1 Eclipses: What Causes an Eclipse? Page 28 TC	Day 5	40 minutes	Verify with models and cite evidence that the moon's apparent shape and position change. 5-2.D.2.e Recognize and describe the causes of the repeating patterns of celestial events. 5-2.D.2	Lunar eclipses happen 1-3 times a year. Describe the cause of this celestial event.
4:1 The Reasons for the Seasons: Why Does the Earth Have Seasons? Page 38 TC <i>Skip 4.2 Shadows Move Through the Year – do shadows in the Light unit</i>	Day 6	40 minutes	Provide evidence that supports the idea that our solar system is sun-centered. 5-2.D.1.e Describe the revolution of the planet Earth around the sun. 5-2.D.2.c Recognize and describe that the revolution of the planet Earth produces effects. -Length of year 5-2.D.2.d	No assessment question today. These indicators are assessed in the next lesson.
Supplemental Lesson Seasons	Day 7	40 minutes	Provide evidence that supports the idea that our solar system is sun-centered. 5-2.D.1.e Describe the revolution of the planet Earth around the sun. Recognize and describe that the revolution of the planet Earth produces effects. -Length of year 5-2.D.2.d	The revolution of the planet Earth produces effects. Explain how Earth's tilt and movement around the sun creates seasons.

APPENDIX B (CONTINUED)

Time Management Guide
Space Grade 4
20 days

Section : Investigation	Day	Time Needed	Indicator	Assessment Question
4:3 The Reasons for the Seasons: Angle and Brightness Page 42 TG	Day 8	40 minutes	Recognize and describe that the temperature of and object increases when heat is added and decreases when heat is removed. 3-5.B.1.a	Is the sun's energy stronger in the middle of the day, when it is high in the sky, or in the late afternoon, when it hits the ground at a very slanted angle? Explain.
Supplemental Lesson Reading a Thermometer/Celsius Page 52 TG Skip 5:1 Sunlight Angle and Energy: Angle and Temperature Page 53 TG	Day 9	40 minutes	Select and use appropriate tools, hand lens or microscope (magnifiers), centimeter ruler (length), spring scale (weight), balance (mass), Celsius (thermometer), graduated cylinder (liquid volume), and stopwatch (elapsed time) to augment observations of objects, events, and processes. 1-A.1.b	Label the thermometer with the temperatures and the seasons best associated with them. Then fill in the blanks below. Water freezes at _____. Water boils at _____.
5:2 Sunlight Angle and Energy: Turning Sunlight into Electricity Page 55 TG	Day 10	40 minutes	Develop explanations using knowledge possessed and evidence from observations, reliable print resources, and investigations. 1-B.1.a	Draw and label what you could do to make the motor go very fast.



APPENDIX B (CONTINUED)

Time Management Guide
Space Grade 4
20 days

Section : Investigation	Day	Time Needed	Indicator	Assessment Question
6:1 The Planets: Make a Model Solar System Page 67 TG	Day 11	40 minutes	Identify the sun as the Earth's closest star. 4-2.D.1.b Identify the properties of the planet Earth that make it possible for the survival of life as we know it. •Temperature •Location •Presence of an atmosphere •Presence of water (solid, liquid, and gas) 5-2.D.1.b	Why is Earth's location in space important to the survival of life on Earth?
Supplemental Lesson Comparing the Properties of Planets Skip 7:1 Exploring a Mystery Planet and 7:2 Receiving a Satellite Image These could possibly be done as stations if you want.	Day 12, 13, and 14	40 minutes each day	Identify the properties of the planet Earth that make it possible for the survival of life as we know it. •Temperature •Location •Presence of an atmosphere •Presence of water (solid, liquid, and gas) 5-2.D.1.b Compare the properties of at least one other planet in our solar system to those of Earth to determine if it could support life, as we know it. 5-2.D.1.c	What are the properties of Earth that make it possible for the survival of life as we know it? •Be sure to explain why those properties are important. •Be specific in your explanation.

APPENDIX B (CONTINUED)

Time Management Guide
Space Grade 4
20 days

Section : Investigation	Day	Time Needed	Indicator	Assessment Question
Supplemental Lesson Comets, Asteroids, Meteors Powerpoint	Day 15	40 minutes	Identify and describe physical properties of comets, asteroids, and meteors. 5-2.D.1.d	Identify at least 2 physical properties of comets, meteors, and asteroids.
8:1 Observing Constellations: Looking Through a Telescope Page 92 TG	Day 16	40 minutes	Recognize and describe that the stars are not all the same in apparent brightness. 4-2.D.1.d Recognize that the pattern of stars in the sky stays the same although their locations in the sky appear to change with the seasons. 4-2.D.1.e Observe and describe the stars and the planets as seen through a telescope, graphically in pictures or in video clips from reliable resources. 4-2.D.1.a	When looking through a telescope some stars appear to be brighter than others. Why are some stars brighter? Give evidence from your reading.
Supplemental Lesson Constellations and Stars	Day 17	40 min	Recognize and describe that the revolution of the planet Earth produces effects. *The observable patterns of stars in the sky stay the same although different stars can be seen in different seasons. 5-2.D.2.d	Describe why different stars can be seen in different seasons. Use evidence from the classroom activity.

APPENDIX B (CONTINUED)

Time Management Guide
Space Grade 4
20 days

Section : Investigation	Day	Time Needed	Indicator	Assessment Question
8:2 Observing Constellations: Observing Constellations Page 95 TC	Day 18	40 minutes	Recognize and describe that the rotation of planet Earth produces observable effects •The day and night cycle •The apparent movement of the sun, moon, planets, and stars 5-2.D.2.b Recognize that stars are like the sun, some are smaller and some larger. 4-2.D.1.c	When you look at the night sky just after sunset, you may notice a constellation near the horizon. Later that night the same constellation is higher in the sky. Explain why this happened?
Review or Flex Day	Day 19	40 minutes		
Assessment/Closure	Day 20	40 minutes		

Materials Ordering Information: Materials can be ordered through the Taylor Science Center. The order forms are available on www.fcpssteach.org

APPENDIX C

Mrs. Z's class, June 9, 2010. Written responses to the question, What was it like to participate in the Samoan Circle?

- 01 It was like being in a real science talk, what real scientists do. So it was fun. I didn't participate but it looked cool.
- 02 I didn't get to participate in the circle. I saw people talking to each other and sharing.
- 03 absent
- 04 Student not in study
- 05 It was fun participating in the Samoan circle. We asked questions about space like asteroids, meteors and comets.
- 06 It was really fun participating in a Samoan circle! It was really fun because you got to interact like standing up. And, being able to talk stuff!! And we got to be recorded! You got to answer questions and stuff. I love it!!
- 07 It was great I would like to participate but it looked fun to be in a Samoan circle the questions were bectailed.
- 08 I think that the Samoan circle was cool because we got to ask questions and sometimes we even get to answer those questions. Once I asked a question and it got answered now I know the answer to my question. The Samoan circle really helps you!
- 09 It was kind of embarrassing. I didn't like saying my thoughts in front of the group.
- 10 I didn't get to it because I wasn't chosen so you guys talk about stuff.
- 11 Well I like it because we can talk about and discuss about space. Also we can ask questions about space and we can discover about space. Lastly we can have fun. Also we can solve questions about space.
- 12 I was cool being in a Samoan Circle because you get to ask questions about space and discuss them.
- 13 It was a fun way to tell what you know ex. I heard that the moon doesn't move. I heard that it does, really. The were in a Samoan circle.

APPENDIX C (Continued)

- 14 It was cool participating in a Samoan circle. In a Samoan circle you get to share your ideas to others. You can ask questions and people can answer the question you asked.
- 15 Student not in study.
- 16 I thought it was fun because it was a 4-person group talking and sharing information. Then you would have the audience recording and learning what they said. I liked how you would also hold props to help you.
- 17 Well it was a place to ask questions and answer them, (also like comments.) I was in the 1st group. We had to answer questions and state comments about the moon and stuff. It was fun, you learn more.
- 18 Absent
- 19 I didn't participate but I would like to.
- 20 Student not in study.
- 21 Well I didn't participate in Samoan Circle. But if I was I would ask questions about space and science. Like how long does it take to get to space. Or how big is earth.
- 22 It was fun. I heard people talking about black holes and different kinds of moons. I saw people really answering questions. It was so cool.
- 23 I like that it was a little group. It was awesome to share what we had to say about the faces of the moon. It was even more fun talking TO my friends. I liked when we just had to raise our hand and in less than 2 sec. you could share what you thought.
- 24 Student not in study

APPENDIX D

Mrs. Z's class, May 19, 2010. Written responses to the question, What is the meaning of Inquiry to you?

- 01 To make an investigation. I want to be in a space class. Space is cool to do so I would do space.
- 02 It means that you need responsibility. And you need to know about science. And you need to know a science word.
- 03 To me inquiry is to find evidence and to use it about space.
- 04 Student not in study
- 05 It is like we have invesagations to math. I like it wif mr. horns class. I also like mis. Ridnors class.
- 06 I do not know what inquiry means. Maybe it means space!! I really don't know: Asking questions then finding facts. When we ask question we find our information. Some facts!
- 07 Inquiry means to ask questions like "How" far is a Black Hole? So now you know that inquiry means to ask questions to someone about space, language arts any thing.
- 08 I think it means to ask a question to find evidence and investigations to find the answer! If we didn't hav Inquiry we wouldn't have learned what we know now!
- 09 I think it means asking questions, learning new things. I ask questions in Mr. Horne's class. I learn new things and sometimes examine things.
- 10 Make me feel happy and fun.
- 11 Inquiry means to me asking a question to find out a fact. So I inquiry mr. horn about the sun. in class we inquiry mr. horn for facts.

APPENDIX D (Continued)

- 12 I think it means to me that you can make an investigation about something you chose to investigate.
- 13 I like a inquiry class because you can ask about what you don't understand like mabe why does it get dark at nigh. I learn more in a inquiry class it helps me more.
- 14 To find out about something. OR to investigate about space. I fell good that I could ask questions. If I couldn't ask questions everything would be boring.
- 15 Student not in study
- 16 Inquiry I think means a question of some-sort. Something someone asks like a request. To find something out. Being in a Inquiring class is fun, learning stuff and getting asked questions for research.
- 17 To me it means to request a question. Or even request a answer! And a investigation.
- 18 Absent
- 19 Absent
- 20 Student not in study
- 21 Well I really do not no what it means but I think it means like what it's like being in Mr. Horns class. Also some things I expected. Also ask questions about space and science.
- 22 Absent
- 23 I think inquiry is a question or an investigation. Also it's a discovery of information. So that means what do you think of having a space room? I love it and also im learning alot.
- 24 Student not in study

APPENDIX E – Parent Cover Letter – Student Conversants

November 18, 2009

Dear Parent or Guardian,

Let me introduce myself. I am the curriculum specialist for elementary science... This is my 20th year.... Ms. B, your school principal, and Mrs. Z, your child's classroom teacher, have welcomed me to work in your child's classroom as part of my doctoral research study through the University of Maryland, College Park.

Over the past ten years I have done preliminary studies similar to this one in a variety of elementary schools including: BC Elementary, DC Elementary, L Elementary, V Elementary, and your school, W Elementary. You may recall the many years I worked in Mrs. V's class on science related activities including the space day design challenges. In 2005-06 I coached a space day team at Walkersville that won best overall for the "Stretch and Fetch" challenge.

The specifics of my research project are fully explained in the attached Parent Consent Form. Please read the packet of information carefully. I will conduct the study during January and February of 2010 in Mrs. Z's classroom.

I will be happy to answer any questions you may have. I can be reached by phone at 301-644-5057 or by email at chris.horne@fcps.org. You should also feel free to contact my advisor at the University of Maryland, Dr. Francine Hultgren. She can be reached at 301-405-4562 or by email at fh@umd.edu.

I hope you will give consent, because this is an exciting opportunity to contribute to science education! Please sign the enclosed consent form and return it to Mrs. Z as soon as possible.

Yours Sincerely,



Chris Horne,
Curriculum Specialist for Elementary Science

APPENDIX E (CONTINUED) – Parent Cover Letter – Former Students

March 8, 2011

Dear Parent or Guardian,

Let me introduce myself. I am the curriculum specialist for elementary science for... This is my 21st year in... I am contacting you because your son/ daughter were enrolled in a 4th grade class I taught with Mrs. V several years ago. I am collecting data on the experiences of 4th graders in the space science classroom as part of my doctoral research study through the University of Maryland, College Park.

Over the past ten years I have done preliminary studies on student experiences in the space science classroom in a variety of elementary schools including: BC Elementary, DC Elementary, L Elementary, V Elementary, and your former elementary school, W Elementary. You may recall the many years I worked in Mrs. V's class on science related activities including the space day design challenges. In 2005-06 I coached a space day team...that won best overall for the "Stretch and Fetch" challenge.

The specifics of my research project are fully explained in the attached Parent Consent Form. Please read the packet of information carefully. I will conduct the student conversations during the spring of 2011 at ...

I will be happy to answer any questions you may have. I can be reached by phone at 301-644-5057 or by email at chris.horne@fcps.org. You should also feel free to contact my advisor at the University of Maryland, Dr. Francine Hultgren. She can be reached at 301-405-4562 or by email at fh@umd.edu.

I hope you will give consent, because this is an exciting opportunity to contribute to science education! Please sign the attached consent form and return it to me as soon as possible.

Yours Sincerely,



Chris Horne,
Curriculum Specialist for Elementary Science

APPENDIX F - – Parent Consent Form – Student Conversants

Page 1 of 4

Initials _____ Date _____

PARENT CONSENT FORM

Project Title	Giving Children Space: A Phenomenological Exploration of Student Experiences in Space Science Inquiry
Why is this research being done?	<p>This is a research project being conducted by Christopher Horne under the guidance of Dr. Francine Hultgren at the University of Maryland, College Park. We are inviting your child to participate in this research project because your child is enrolled in Mrs. Z’s 4th grade class.</p> <p>The purpose of this research project is to allow students to tell about their experience in the inquiry-based space science classroom so that educators can better understand teaching and learning in this setting from a student’s point of view.</p>
What will your child be asked to do?	<p>Your child will participate in the regular activities of the space science classroom during a 4-6 week period during January and February, 2010. The curriculum is entitled <i>Experience Science: Space</i>, an inquiry-based module by Houghton Mifflin. Portions of some lessons will be audiotaped and later transcribed. Lessons which include classroom conversations are most likely to be recorded. During these activities, questions will be presented to the group followed by open conversations. Questions may include: Why does it get dark at night? Why is it colder in Maryland in the winter and warmer in the summer? What if there was no moon? What questions do you have about space which have not been answered? What space science vocabulary words still don’t make sense to you? What do you wonder about space? What is inquiry-based science to you? Describe what it was like when you participated in _____. What is the meaning of science to you? What is the meaning of space science to you?</p> <p>Groups of approximately 6 students will move to a separate location to participate in small group conversations for no longer than 30 minutes with topics relevant to the space science classroom experience as listed above. Written reflections of classroom experiences will also be collected.</p>

APPENDIX F (CONTINUED)

Project Title	Giving Children Space: A Phenomenological Exploration of Student Experiences in Space Science Inquiry
What about confidentiality?	<p>We will do our best to keep your child's personal information confidential. To help protect your confidentiality, (1) Pseudonyms (made-up names) will be assigned to your child. Any reference to your child in the final report will list only a first name pseudonym. (2) Your child's work samples, journal entries, and other written assignments will be copied with names blocked out and pseudonyms added. All original work will be returned to your child promptly. (3) This research project involves recording audiotapes of your child. Only the investigator (Mr. Horne) and transcriber will have access to the audiotaped conversations. The audiotapes will be kept at the investigator's home in a locked cabinet for a period of ten years and then destroyed. (4) Transcribed conversations, all copied materials, consent forms, and any related computer files will be held at the investigator's home in a locked cabinet for ten years and then destroyed.</p> <p>___ I agree to my child being audiotaped during his/her participation in this study. ___ I do not agree to my child being audiotaped during his/her participation in this study.</p> <p>If we write a report or article about this research project, your child's identity will be protected to the maximum extent possible. Your child's information may be shared with representatives of the University of Maryland, College Park or governmental authorities if your child or someone else is in danger or if we are required to do so by law.</p> <p>In accordance with legal requirements and/or professional standards, any information revealed during these conversations that disclose acts of child abuse and/or neglect upon the child will be reported to the appropriate authorities</p>

APPENDIX F (CONTINUED)

<p>Project Title</p>	<p>Giving Children Space: A Phenomenological Exploration of Student Experiences in Space Science Inquiry</p>
<p>What are the risks of this research?</p>	<p>There is a risk that participants in this study may experience some level of stress through their participation in audiotaped conversations.</p> <p>Your child will be encouraged to ask the researcher questions throughout the duration of the study and will be informed that they may withdraw from the study at any time without penalty.</p>
<p>What are the benefits of this research?</p>	<p>There are potential benefits since students engaged in inquiry-based science and reflection on their own thinking and learning will strengthen their understanding of the content and develop a deeper understanding of their ability to learn. Students will engage in conversation with the teacher and write paragraphs detailing aspects of the inquiry-based experience, but will only share what they wish to. No grades or requirements are placed on students in terms of participation in conversations or quality of written reflections relative to this study. The investigator will not probe into personal information regarding the students, but will ask students to share stories relevant to the inquiry-based experience in the space science classroom.</p> <p>This research is not designed to help your child personally, but the results may help the investigator learn more about how 4th graders experience the inquiry-based classroom. We hope that, in the future, other people might benefit from this study through improved understanding of teaching and learning in the elementary classroom.</p>
<p>Does my child have to be in this research? May I stop my child's participation at any time?</p>	<p>Your child's participation in this research is completely voluntary. While your child's involvement in class discussions and assignments is part of the curriculum, you can still choose for your child's contributions to not be a part of the research report. If you decide to allow your child to participate in this research, you may request to stop her/his participation at any time. If you decide not to allow your child to participate in this study or if you stop participation at any time, your child will not be penalized or lose any benefits to which they otherwise qualify.</p> <p>Your child will be encouraged to ask the researcher questions throughout the duration of the study and will be informed that they may withdraw from the study at any time without penalty.</p>

APPENDIX F (CONTINUED)

Project Title	Giving Children Space: A Phenomenological Exploration of Student Experiences in Space Science Inquiry	
What if I have questions?	<p>This research is being conducted by Christopher Horne under the guidance of Dr. Francine Hultgren at the University of Maryland, College Park. If you have any questions about the research study itself, please contact Dr. Francine Hultgren at: 3110 Benjamin Building, EDPS, University of Maryland, College Park, 20742 (email) fh@umd.edu or (telephone) 301-405-4562.</p> <p>If you have questions about your child’s rights as a research subject or wish to report a research-related injury, please contact: Institutional Review Board Office, University of Maryland, College Park, Maryland, 20742; (e-mail) irb@umd.edu; (telephone) 301-405-0678.</p> <p>This research has been reviewed according to the University of Maryland, College Park IRB procedures for research involving human subjects.</p> <p>You will be provided with a copy of this consent form and your child’s completed assent form. Your child will also be provided with a copy of their completed assent form.</p>	
Statement of Age of Subject and Consent	<p><i>Your signature indicates that: the research has been explained to you; your questions have been fully answered; and you freely and voluntarily choose for your child to participate in this research project.</i></p>	
Signature and Date	NAME OF SUBJECT	
	SIGNATURE OF SUBJECT’S PARENT/LEGAL GUARDIAN	
	DATE	

APPENDIX F (CONTINUED) - – Parent Consent Form – Former Student

Page 1 of 3

University of Maryland, College Park

Initials _____ Date _____

Project Title	Giving Children Space: A Phenomenological Exploration of Student Experiences in Space Science Inquiry
Purpose of the Study	<p>This is a research project being conducted by Christopher Horne under the guidance of Dr. Francine Hultgren at the University of Maryland, College Park. We are inviting your child to participate in this research project because your child was enrolled in Mrs. V's and Mr. Horne's 4th grade space science class.</p> <p>The purpose of this research project is to allow students to tell about their experience in the inquiry-based space science classroom so that educators can better understand teaching and learning in this setting from a student's point of view.</p>
Procedures	<p>Your child will respond to a series of questions about the inquiry-based space science classroom she/he participated in during 4th grade at W Elementary 7 years ago during the 2003-04 school-year.</p> <p>One-on-one or small group conversations will be held discussing topics relevant to the space science classroom experience. Written reflections of classroom experiences will also be collected.</p> <p>During the conversations, questions will be addressed including: What is inquiry-based science to you? Describe what it was like when you participated in _____. What is the meaning of science to you? What is the meaning of space science to you?</p> <p>All participants will be encouraged to ask the researcher questions throughout the duration of the study and will be informed that they may withdraw from the study at any time without penalty.</p>
Potential Risks and Discomforts	<p>There are no known risks associated with participating in this research project.</p>

APPENDIX F (CONTINUED) - -- Parent Consent Form – Former Student

Page 2 of 3

University of Maryland, College Park

Initials _____ Date _____

<p>Potential Benefits</p>	<p>There are potential benefits since students engaged in inquiry-based science and reflection on their own thinking and learning will strengthen their understanding of the content and develop a deeper understanding of their ability to learn. Students will engage in conversation with the teacher and write a reflection detailing aspects of the inquiry-based experience, but will only share what they wish to. No requirements are placed on students in terms of participation in conversations or quality of written reflections relative to this study. The investigator will not probe into personal information regarding the students, but will ask students to share stories relevant to the inquiry-based experience in the space science classroom.</p> <p>This research is not designed to help your child personally, but the results may help the investigator learn more about how 4th graders experience the inquiry-based classroom. We hope that, in the future, other people might benefit from this study through improved understanding of teaching and learning in the elementary classroom.</p>
<p>Confidentiality</p>	<p>We will do our best to keep your child’s personal information confidential. To help protect your confidentiality, (1) Pseudonyms (made-up names) will be assigned to your child. Any reference to your child in the final report will list only a first name pseudonym. (2) Your child’s written reflections will be copied with names blocked out and pseudonyms added. (3) This research project involves recording audiotapes of your child. Only the investigator (Mr. Horne) and transcriber will have access to the audiotaped conversations. The audiotapes will be kept at the investigator’s home for a period of ten years and then destroyed. (4) Transcribed conversations, all copied materials, consent forms, and any related computer files will be held by the investigator for ten years and then destroyed.</p> <p>___ I agree to my child being audiotaped during his/her participation in this study.</p> <p>___ I do not agree to my child being audiotaped during his/her participation in this study.</p> <p>If we write a report or article about this research project, your child’s identity will be protected to the maximum extent possible. Your child’s information may be shared with representatives of the University of Maryland, College Park or governmental authorities if your child or someone else is in danger or if we are required to do so by law.</p> <p>In accordance with legal requirements and/or professional standards, any information revealed during these conversations that disclose acts of child abuse and/or neglect upon the child will be reported to the appropriate authorities</p>
<p>Medical Treatment</p>	<p>The University of Maryland does not provide any medical, hospitalization or other insurance for participants in this research study, nor will the University of Maryland provide any medical treatment or compensation for any injury sustained as a result of participation in this research study, except as required by law.</p>

APPENDIX F (CONTINUED) - - Parent Consent Form – Former Student

Page 3 of 3

University of Maryland, College Park

Initials _____ Date _____

<p>Right to Withdraw and Questions</p>	<p>Your child’s participation in this research is completely voluntary. If you decide to allow your child to participate in this research, you may request to stop her/his participation at any time before publication of the work.</p> <p>If you have any questions about the research study itself, if you decide to stop taking part in the study, if you have questions, concerns, or complaints, or if you need to report an injury related to the research, please contact the investigator Dr. Francine Hultgren at: 3110 Benjamin Building, EDPS, University of Maryland, College Park, 20742 (email) fh@umd.edu or (telephone) 301-405-4562.</p> <p>If you have questions or concerns for the student investigator, Christopher Horne, you can reach him at: 191S. East Street, Frederick, MD 21701 (email) chris.horne@fcps.org or (telephone) 301-644-5057</p>	
<p>Participant Rights</p>	<p>If you have questions about your rights as a research participant or wish to report a research-related injury, please contact:</p> <p align="center"> University of Maryland College Park Institutional Review Board Office 1204 Marie Mount College Park, Maryland, 20742 E-mail: irb@umd.edu Telephone: 301-405-0678 </p> <p>This research has been reviewed according to the University of Maryland, College Park IRB procedures for research involving human subjects.</p>	
<p>Statement of Consent</p>	<p>Your signature indicates that you are at least 18 years of age; you have read this consent form or have had it read to you; your questions have been answered to your satisfaction and you voluntarily agree to have your child participate in this research study. You will receive a copy of this signed consent form.</p> <p>If you agree to have your child participate, please sign your name below.</p>	
<p>Signature and Date</p>	<p>NAME OF STUDENT (SUBJECT)</p> <p>NAME OF SUBJECT’S Parent/guardian [Please Print]</p>	
	<p>SIGNATURE OF SUBJECT’S parent/guardian</p>	
	<p>DATE</p>	

APPENDIX G – Student Assent Form – Student Conversants
STUDENT ASSENT FORM

Giving Children Space: A Phenomenological Exploration of Student Experiences in Space Science Inquiry

You can be part of a research project being conducted by Mr. Horne under the guidance of Dr. Hultgren at the University of Maryland, College Park. You are invited to participate in this research project because you are in Mrs. Z's 4th grade class.

The purpose of this research project is to allow you to tell about your experiences in the inquiry-based space science classroom so that teachers can better understand teaching from a student's point of view.

You will participate in the regular activities of the space science classroom. Parts of some lessons will be audiotaped. Several times you and a group of about 6 students will move to a separate room for no longer than 30 minutes to have small-group conversations about space and the space science classroom. These conversations will be audiotaped too.

We will do our best to keep your personal information private. To help protect your privacy, (1) Made-up names will be used for you in the report that is written by Mr. Horne. (2) Your written work will be copied with your name blocked out and a made-up name added. All your written work will be returned to you right away. (3) This research project involves making audiotapes of class conversations.

Check one choice below:

I agree to being audiotaped during this study.

I do not agree being audiotaped during this study.

The research results can help Mr. Horne learn more about how 4th graders experience a space science classroom. We hope that, in the future, other people might benefit from this study through improved understanding of teaching and learning in the elementary classroom.

Page 1 of 2 Initials _____ Date _____

APPENDIX G (CONTINUED)

There is a risk that you may experience some level of stress through participation in audiotaped conversations. There are potential benefits since doing inquiry-based science and reflecting on your own thinking and learning will help you understand science and how you learn.

You will have conversations with Mrs. Z and Mr. Horne and do short writing assignments, but will only share what you wish to. Mrs. Z and Mr. Horne will not ask you for personal information, but will ask you to share stories about the inquiry-based experience in the space science classroom.

Your participation in this research is completely your choice. While you will still be part of the class discussions and assignments, you can still choose for your contributions to not be a part of Mr. Horne's research report. You should always feel free to ask Mr. Horne questions about the study at any time. If you decide to be part of this research, you may request to stop at any time. If you decide not to do this study or if you stop at any time, you will not be marked down or lose any benefits.

If you have questions or concerns about this study, please tell your teacher, Mrs. Z or your parents.

You will be provided with a copy of this completed assent form. Your parents/guardians will be provided with a copy of this form and their completed consent form.

Write your name to show that:

1. The research has been explained to you;
2. Your questions have been fully answered;
3. You freely and voluntarily choose to participate in this research project.

Name _____

Date _____

APPENDIX G (CONTINUED) Student Assent Form – Former Student
STUDENT ASSENT FORM

Giving Children Space: A Phenomenological Exploration of Student Experiences in Space Science Inquiry

You can be part of a research project being conducted by Mr. Horne under the guidance of Dr. Hultgren at the University of Maryland, College Park. You are invited to participate in this research project because you are a former member of Mrs. V's and Mr. Horne's 4th grade space science class.

The purpose of this research project is to allow you to tell about your experiences in the inquiry-based space science classroom so that teachers can better understand teaching from a student's point of view.

At a time and place of your choosing, you and Mr. Horne will have one-on-one, or small group conversations (you can choose to include a friend in the discussion) about space and the space science classroom. These conversations will be audiotaped.

We will do our best to keep your personal information private. To help protect your privacy, (1) Made-up names will be used for you in the report that is written by Mr. Horne. (2) Your written comments will be copied with your name blocked out and a made-up name added. (3) This research project involves making audiotapes of conversations.

Check one choice below:

- I agree to being audiotaped during this study.
 I do not agree being audiotaped during this study.

The research results can help Mr. Horne learn more about how 4th graders experience a space science classroom. We hope that, in the future, other people might benefit from this study through improved understanding of teaching and learning in the elementary classroom.

APPENDIX G (CONTINUED)

There are potential benefits since doing inquiry-based science and reflecting on your own thinking and learning will help you understand science and how you learn.

You will have conversation with Mr. Horne and do a short writing assignment, but will only share what you wish to. Mr. Horne will not ask you for personal information, but will ask you to share stories about the inquiry-based experience in the space science classroom.

Your participation in this research is completely your choice. If you decide to be part of this research, you may request to stop at any time.

If you have questions or concerns about this study, please contact Dr. Hultgren at the University of Maryland or your parents.

Print your name and sign below to show that:

1. The research has been explained to you;
2. Your questions have been fully answered;
3. You freely and voluntarily choose to participate in this research project.

Name _____

Student Signature _____

Date _____

Contact Information:

Mr. Chris Horne, Curriculum Specialist for Elementary Science
191 S. East Street
Frederick, Maryland 21701
301-644-5057
Chris.horne@fcps.org

Dr. Francine Hultgren
2110 Benjamin Building,
UMD, College Park, Maryland 20742
301-405-4562
fh@umd.edu

References

- Abram, D. (1996). *The spell of the sensuous*. New York: Vintage Books.
- Achieve website. (2011). Next generation science standards.
<http://www.achieve.org/next-generation-science-standards>
- American Association for the Advancement of Science. (1993). *Benchmarks for science literacy*. New York: Oxford University Press.
- American Heritage Dictionary On-line. (2007). <http://dictionary.reference.com>.
- Aoki, T. (1987). Inspiring the curriculum. In W. Pinar & R. Irwin (Eds.), *Curriculum in a new key: The collected works of Ted T. Aoki* (pp. 357-365). Mahwah, NJ: Lawrence Erlbaum.
- Aoki, T. (1993). Legitimizing lived curriculum: Toward a curricular landscape of multiplicity. In W. Pinar & R. Irwin (Eds.), *Curriculum in a new key: The collected works of Ted T. Aoki* (pp. 199-215). Mahwah, NJ: Lawrence Erlbaum.
- Applebee, A. (1996). *Curriculum as conversation: Transforming traditions of teaching and learning*. Chicago: University of Chicago Press.
- Bachelard, G. (1994). *The poetics of space*. Boston: Beacon Press.
- Barnes, D. (1992). *From communication to curriculum*, second edition. Portsmouth, NH: Boynton/Cook.
- Berman, L. (1991). Dwelling: A return. In L. Berman, F. Hultgren, D. Lee, M. Rivkin, & J. Roderick, *Toward curriculum for being: Voices of educators* (pp. 185-189). Albany: State University of New York Press.
- Block, A. (1998). 'And he pretended to be a stranger to them...' Maxine Greene and teacher as stranger. In W. Pinar (Ed.), *The passionate mind of Maxine Greene: 'I am not yet'* (pp. 14-29). PA: Falmer Press.
- Braveheart* (1995). DVD, CA: Paramount Pictures.
- Brooks, J. G., & Brooks, M. G. (1993). *In search of understanding: The case for constructivist classrooms*. Alexandria, VA: ASCD.
- Bryson, B. (1998). *A walk in the woods*. New York: Broadway Books.
- Burke, J. (1996). *Stories from the stars*. New York: Abbeville Publishing Group.

- Carson, R. (1998). *The sense of wonder*. New York: HarperCollins. (Original work published in 1956)
- Casey, E. (1993). *Getting back into place: Toward a renewed understanding of the place world*. Bloomington: Indiana University Press.
- Casey, E. (2000). *Remembering: A phenomenological study*, second edition. Bloomington: Indiana University Press.
- Cobb, W., Rountree-Brown, M., McFadden, L., & Warner, E. (2011). Inquiry into the heart of a comet: Third through fifth-grade students model science in action. *Science and Children*, 48 (6), 46-49.
- Darling-Hammond, L., & MacDonald, M. (2000). Where there is learning there is hope: The preparation of teachers at the Bank Street College of Education. In L. Darling-Hammond (Ed.), *Studies of excellence in teacher education: Preparation at the graduate level* (pp. 1-95). Brooklyn: American Association of Colleges for Teacher Education.
- Department of Sustainability and Environment website. (2007). Description of the samoan circle. Victoria, Australia.
<http://www.dse.vic.gov.au/effective-engagement/toolkit/tool-samoan-circles>.
- Dewey, J. (1910). *How we think*. New York: D.C. Heath & Co.
- Dewey, J. (1997). *Experience and education*. New York: Touchstone. (Original work published in 1938)
- Dubay, T. (1999). *The evidential power of beauty*. San Francisco: Ignatius Press.
- DuFour, R. (2004). What is a professional learning community? *Educational leadership*, 61(8), 6-11.
- Dylan, B. (1974). Forever young. *Planet waves*. CD, New York: Columbia Records.
- Dylan, B. (1975). Tangled up in blue. *Blood on the tracks*. CD, New York: Columbia Records.
- Dylan, B. (2004). *Bob Dylan chronicles: Volume I*. New York: Simon and Schuster.
- Eldredge, J. (2006). *The way of the wild heart*. Nashville, TN: Thomas Nelson.
- Experience Science: Space Teachers Guide*. (2007). Boston: Houghton Mifflin.
- Flaherty, M. (1999). *A watched pot: How we experience time*. NY: New York University Press.

- Freire, P. (1998). *Pedagogy of freedom: Ethics, democracy, and civic courage*. Lanham, MD: Rowan & Littlefield.
- Freire, P. (2000). *Pedagogy of the oppressed*. New York: Continuum. (Original work published in 1970)
- Gadamer, H.-G. (1989). *Truth and method*, second revised edition (J. Weinsheimer & D. G. Marshall, trans.). New York: Continuum. (Original work published 1960)
- Gadamer, H.-G. (2001). *Gadamer in conversation – Reflections and commentary* (R. Palmer, ed. & trans.). New Haven, CT: Yale University Press.
- Gallas, K. (1995). *Talking their way into science*. New York: Teachers College Press.
- Gentry, M., & Mann, R. (2008). *Total school cluster grouping & differentiation*. Mansfield Center, CT: Creative Learning Press.
- Glenn, J. (1999). *John Glenn: A memoir*. New York: Bantam Books.
- Goldberg, J. (1996). *Albert Einstein: The rebel behind relativity*. Danbury, CT: Franklin Watts.
- Gore, J. (1993). *The struggle for pedagogies*. New York: Routledge.
- Greene, M. (1988). *The dialectic of freedom*. New York: Teachers College Press.
- Greene, M. (1998). Toward beginnings. In W. Pinar (Ed.), *The passionate mind of Maxine Greene: 'I am not yet'*. (pp. 256-257). PA: Falmer Press.
- Hammer, D., & van Zee, E. (2006). *Seeing the science in children's thinking: Case studies of student inquiry in physical science*. Portsmouth, NH: Heinemann.
- Heard, G. (1999). *Awakening the heart: Exploring poetry in elementary and middle school*. Portsmouth, NH: Heinemann.
- Heard, G., & McDonough, J. (2009). *A place for wonder: Reading and writing nonfiction in the primary grades*. Portland, ME: Stenhouse Publishers.
- Heidegger, M. (1962). *Being and time* (J. Macquarrie & E. Robinson, trans.). New York: Harper & Row. (Original work published in 1927)
- Heidegger, M. (1968). *What is called thinking?* (J. G. Gray, trans.). New York: HarperCollins.

- Heidegger, M. (1971). *Poetry, language, and thought* (A. Hofstadter, trans.). New York: HarperCollins.
- Heidegger, M. (1993a). Introduction to being and time. In D. F. Krell (Ed.), *Martin Heidegger: Basic writings* (pp. 41-87). New York: HarperCollins. (Original work published in 1927)
- Heidegger, M. (1993b). Letter on humanism. In D. F. Krell (Ed.), *Martin Heidegger: Basic writings* (pp. 217-265). New York: HarperCollins. (Original work published in 1947)
- Hickam, H. (1998). *October sky: A memoir*. New York: Dell. (Originally published as *Rocket Boys*)
- Horne, C. (1999). Using moon models: Is “hands-on” really enough? *MAST Rapper, Official Publication of the Maryland Association of Science Teachers*, 24 (4), 16-20.
- Horne, C. (2007a). Becoming a teacher researcher: Giving space, finding space. In D. Roberts, C. Bove, & E. van Zee (Eds.), *Teacher research: Stories of learning and growing* (pp. 100-109). Danvers, MA: NSTA Press.
- Horne, C. (2007b). *Playing with math...The name of the game*. Middletown, MD: School Neuropsych Press.
- Hornsby, R. (2008). What does Heidegger mean by being in the world? <http://royby.com/philosophy/pages/dasein.html>.
- Hubblesite* website. (2011). Hubble’s Deepest view of the universe unveils bewildering galaxies across billions of years, <http://hubblesite.org/newscenter/archive/releases/1996/01/text/>
- Hultgren, F. (1995). The phenomenology of “doing” phenomenology: The experience of teaching and learning together. *Human Studies*, 18, 371-388.
- Jardine, D., Clifford, P., & Friesen, S. (2003). *Getting back to the basics of teaching and learning: Thinking the world together*. New York: Lawrence Earlbaum.
- Johnson, P. (2000). *On Gadamer*. Belmont, CA: Wadsworth/Thomson Learning.
- Keller, H. (2003). *The story of my life with supplementary accounts by Anne Sullivan, her teacher, and John Albert Macy*. New York: W.W. Norton & Co. (Original work published 1903)

- Kornblut, A., & Wilson, S. (2011). State of the union, 2011: 'Win the future,' Obama says. *Washington Post Online*. <http://www.washingtonpost.com/wp-dyn/content/article/2011/01/25/AR2011012504068.html>.
- Levin, D. (1989). *The listening self: Personal growth, social change, and the closure of metaphysics*. New York: Routledge.
- Lewis, C.S. (1996). *Mere Christianity*. New York: Simon & Schuster. (Original work published 1952)
- Lingis, A. (2007). *The first person singular*. Evanston, Illinois: Northwestern University Press.
- Loucks-Horsely, S., Kapitan, R., Carlson, M., Kuebis, P., Clark, R., Nelle, G., Sachse, T., & Watson, E. (1990). *Elementary school science for the '90s*. Alexandria, VA: ASCD.
- Louv, R. (2006). *The last child in the woods: Saving our children from nature-deficit disorder*. Chapel Hill, NC: Algonquin Books.
- Maryland State Curriculum*. (2008). Baltimore, MD: Maryland State Department of Education.
- Maryland State Department of Education* press release. (2011). Maryland to help lead broad effort to develop new science standards: Joins 19 states to strengthen science in the classroom. September 20, 2011, Baltimore, MD.
- Maryland State Department of Education* website. (2011a). American recovery and reinvestment act (stimulus funds), <http://marylandpublicschools.org/MSDE/programs/arra/>.
- Maryland State Department of Education* website. (2011b). Educator effectiveness academy information sheet, <http://www.marylandpublicschools.org/NR/rdonlyres/FF6264FE-B70D-4F6A-8484-13E91FB06998/28331/academydocument2811attachmentI.pdf>.
- Maryland State Department of Education* website. (2011c). Master teacher application, <http://www.marylandpublicschools.org/NR/rdonlyres/FF6264FE-B70D-4F6A-8484-13E91FB06998/28332/MasterTeacherApplicationAttachmentII.pdf>.
- Maryland State Department of Education* website. (2011d). Science, technology, engineering, and mathematics (STEM) education, <http://www.marylandpublicschools.org/MSDE/programs/stem/?WBCMODE=pres%25%3E%25%3E>.

- Merleau-Ponty, M. (2002). *The phenomenology of perception*. New York: Routledge. (Original work published 1945)
- Miller, D. (2002). *Reading with meaning: Teaching comprehension in the primary grades*. Portland, ME: Stenhouse Publishers.
- Moran, D. (2000). *Introduction to phenomenology*. New York: Routledge.
- Mullane, M. (1991). *The ten thousand night dream*. VHS Videotape presentation distributed at The National Science Teachers Association Conference, Las Vegas, NV.
- National Research Council. (1996). *National science education standards*. Washington D.C.: National Academy Press.
- National Research Council. (2000). *Inquiry and the national science education standards*. Washington D.C.: National Academy Press.
- National Research Council. (2011). *A framework for K-12 science education: Practices, crosscutting concepts, and core ideas*. Committee on a conceptual framework for new K-12 science education standards. Washington, DC: The National Academies Press.
- NASA Science website. (2011). Hubble discovers a new moon around Pluto. http://science.nasa.gov/science-news/science-at-nasa/2011/20jul_p4/
- National Science Teachers Association website. (2004). Position statement: Scientific inquiry. <http://www.nsta.org/about/positions/inquiry.aspx>
- New Horizons: NASA's Pluto-Kuiper Belt Mission website. (2011a). PI's Perspective. <http://pluto.jhuapl.edu/overview/piPerspective.php>
- New Horizons: NASA's Pluto-Kuiper Belt Mission website. (2011b). Why go to Pluto? <http://pluto.jhuapl.edu/overview/whyGo.php>
- Newton, D. (2002). *Talking sense in science: Helping children understand through talk*. London: Routledge Falmer.
- Noddings, N. (2001). The caring teacher. In V. Richardson (Ed.), *Handbook of research on teaching*, fourth edition (pp. 99-105). Washington D.C.: American Educational Research Association.
- Noddings, N. (2003). *Caring: A feminine approach to ethics and moral education*, second edition. Berkeley: University of California Press.

- Obama, B. (2009). *Address to the National Academies of Science, April 27, 2009*, <http://www.whitehouse.gov/the-press-office/remarks-president-national-academy-sciences-annual-meeting>
- O'Donohue, J. (1997). *Anam cara: A book of celtic wisdom*. New York: HarperCollins.
- O'Donohue, J. (1999). *Eternal echoes: Celtic reflections on our yearning to belong*. New York: HarperCollins.
- O'Donohue, J. (2004). *Beauty: The invisible embrace*. New York: HarperCollins.
- O'Donohue, J. (2008). *To bless the space between us*. New York: Doubleday.
- Onions, C.T. (Ed.). (1966). *The Oxford dictionary of English etymology*. Oxford: Clarendon Press.
- Palmer, P. (1998). *The courage to teach: Exploring the inner landscape of a teacher's life*. San Francisco: Jossey-Bass.
- Palmer, P. (2000). *Let your life speak. Listening for the voice of vocation*. San Francisco: Jossey-Bass.
- Payne, R. (1996). *A framework for understanding poverty*, third revised edition. Highlands, TX: aha! Process.
- Rutherford, F. J., & Ahlgren, A. (1990). *Science for all Americans*. New York: Oxford University Press.
- Shapiro, B. (1994). *What children bring to light: A constructivist perspective on children's learning in science*. New York: Teachers College Press.
- Sinclair, C. (1994). *Looking for home: A phenomenological study of home in the classroom*. Albany: State University of New York Press.
- Sobel, D. (2005). *The planets*. New York: Penguin Group.
- Star Trek* (2009). DVD, CA: Paramount Pictures.
- Stepanek, J. (Ed.). (2005). *Reflections of a peacemaker: A portrait through heartsongs*. Kansas City: Andrews McMeel.
- Stepanek, J. (2009). *Messenger: The legacy of Mattie J.T. Stepanek and heartsongs*. New York: Dutton.
- Stepanek, M. (2001). *Journey through heartsongs*. New York: Hyperion.

- Stepanek, M. (2002a). *Hope through heartsongs*. New York: Hyperion.
- Stepanek, M. (2002b). *Celebrate through heartsongs*. New York: Hyperion.
- Sutter, F. (1984). *Amerika samoa: An Anthropological photo essay*. Honolulu: University of Hawaii Press.
- Taylor, C. (2002). Gadamer on the human sciences. In R. J. Dostal (Ed.), *The Cambridge companion to Gadamer* (pp. 126-142). Cambridge, UK: Cambridge University Press.
- Tuan, Y. (1977). *Space and place: The perspective of experience*. Minneapolis: University of Minnesota Press.
- van Manen, M. (1986). *The tone of teaching*. London, Ontario, Canada: Scholastic.
- van Manen, M. (1991). *The tact of teaching*. London, Ontario, Canada: The Althouse Press.
- van Manen, M. (Ed.). (2002). *Writing in the dark: Phenomenological studies in interpretive inquiry*. London, Ontario, Canada: Althouse Press.
- van Manen, M. (2003). *Researching lived experience: Human science for an action sensitive pedagogy*. Albany: State University of New York Press.
- van Zee, E., Iwask, M., Kurose, A., Simpson, D., & Wild, J. (2001). Student and teacher questioning during conversations about science. *Journal of Research in Science Teaching*, 38 (2), 159-190.
- Vert, C. (2011). Our Sputnik moment: Obama's great misunderstood allegory. *Politicus USA online*. <http://www.politicususa.com/en/obama-sputnik>.
- Washor, E., & Mojkowski, C. (2006/2007). What do you mean by rigor? *Educational leadership*, 64(4), 84-87.
- Warren, R. (2002). *The purpose driven life*. Grand Rapids, MI: Zondervan.
- Webster's new world college dictionary*, fourth edition. (2001). Foster City, CA: IDG Books Worldwide.
- Webster's unabridged encyclopedic dictionary of the English language*. (2001). San Diego: Thunderbay Press.
- Wenger, E. (1998). *Communities of practice: Learning, meaning, and identity*. New York: Cambridge University Press.