UNIVERSITY OF OKLAHOMA

GRADUATE COLLEGE

THE EVOLUTION OF A SCIENCE TEACHER:

AN AUTOBIOGRAPHY

A DISSERTATION

SUBMITTED TO THE GRADUATE FACULTY

in partial fulfillment of the requirements for the

degree of

Doctor of Philosophy

By

DANIEL E. VINCENT
Norman, Oklahoma
2006

ProQuest Information and Learning Company
300 North Zeeb Road
P.O. Box 1346
Ann Arbor, MI 48106-1346

THE EVOLUTION OF A SCIENCE TEACHER:
AN AUTOBIOGRAPHY

A DISSERTATION APPROVED FOR THE
DEPARTMENT OF EDUCATIONAL LEADERSHIP AND POLICY STUDIES

BY

_____
Courtney Vaughn, Ph.D.

_____
Jon Pedersen, Ph.D.

_____
Joan Smith, Ph.D.

_____
Kerry Magruder, Ph.D.

_____
M. Jayne Fleener, Ph.D.

TABLE OF CONTENTS

ABSTRACT

This qualitative study explores the experiences of a science teacher as he seeks to understand the foundations of his pedagogy, his view of learning, and his role as a teacher. By using the autobiographical style of *currere*, the author investigates the significant events of his educational journey and describes the transformation that occurred while teaching science in secondary schools. The author discovers how his instructional methods were intimately linked to his perception of the content and nature of science, how his interactions with others within a learning community challenged him to grow professionally, and how his educational metaphors helped him make sense of teaching, learning, and life. By telling his story, the author/researcher was able to use his transformed notions of how people learn to construct personal meaning about his own educational foundations and pedagogical perspectives, and in turn, give others a story within which they might find their own personal meaning.

Men go abroad to wonder at the heights of mountains,
at the huge waves of the sea,
at the long courses of rivers,
at the vast compass of the ocean,
at the circular motions of the stars;
and they pass by themselves without wondering.
--St. Augustine

PREFACE

Throughout the writing of this autobiography I was challenged to once again examine the assumptions I had about learning, teaching, life, and even the nature of knowledge. Reading through these experiences, one might be drawn, as I was, to three aspects of my story: 1) trying to understand my classroom in terms of metaphors, 2) changing my perspectives when exploring my assumptions about learning and teaching, and 3) working with others to better student learning. These three areas are not unique to just my story, however. Others' stories have been researched and written about in numerous professional journals and have been used as individual topics for investigating teachers, learning, and educational transformation (Berliner, 1990; Caine & Caine, 1997; Cate, Vaughn, & O'Hair, 2006; Collins & Green, 1990; Cranton, 1994; Lackoff & Johnson, 1980; Marshall, 1990; Tobin, 1990).

Using metaphors to guide teaching practices is well documented in pedagogical literature (Berliner, 1990; Caine & Caine, 1997; Fleener, 2002; Marshall, 1990; Tobin, 1990). When I began teaching, I never considered the notion of metaphors as a way to help me understand my teaching. But as Berliner (1990) suggests, "Metaphors are powerful forces, conditioning the way we think of ourselves and others, of events and even nations. They affect our thought in subtle and powerful ways" (p. 85). And the metaphors educators knowingly or unknowing espouse are used, as Tobin (1990) explains, to "guide many of the practices adopted by teachers" (p. 123).

When I finally examined the metaphors I used to understand my classroom, I was able to start the process of understanding my thoughts and ideas about learning, teaching, and even life. This critical reflection has continued through the writing of my autobiography. Tobin continues:

> The metaphors used to make sense of roles and the belief sets associated with particular actions are important factors that might be productive focuses [sic] for reflection. Teachers can identity the salient metaphors for specific teaching roles and consider whether or not alternatives would lead to improvements in the classroom. If teachers decide to alter the metaphors they use to understand particular roles, beliefs previously associated with the role might be perceived to be no longer relevant to that role. Beliefs consistent with the new metaphor can then be deemed relevant and influence what teachers do as they plan and implement the curriculum. (p. 126)

Through this critical self-reflection, and through exploring other metaphors as a way to understand and make meaning out of my experiences in my classroom, a change was made, and is continuing to be made, in how I view learning. Mezirow's work (1991) describes these changes as transformative learning. For me, a perturbation in my thoughts about how the world operated at its most basic level and how science itself operated caused me to examine my assumptions about learning, knowledge, and my role as a teacher. As Cranton (1994) explains when discussing transformative learning:

> Adult learners have assumptions, beliefs, and values that determine the way they interpret the world and their experiences. These assumptions may be

> challenged by people, events, changes in context, crises, or new experiences. The individual may then be led to an examination of his or her assumptions, including their sources and the consequences of holding those assumptions. In critical self-reflection, the learner questions whether or not the assumptions are valid. If this process leads to a change in assumptions, it also leads to a new way of interpreting the world, and transformation has taken place. Actions and behaviors will be changed based on the changed perspective. (p. 730)

However, my conceptual shift was not done in isolation. Not only did my graduate classes and professors challenge me to examine my assumptions and metaphors, my colleagues also pushed me to explore and refine my thoughts on teaching, learning, and life. Cate, Vaughn, and O'Hair (2006) researched a school that transformed itself from a traditional school to a learning community and finally to a democratic school community; I am but one educator's voice in two of these communities. Much of what I experienced during my transformation was a result of my school's atmosphere as a professional learning community, characterized by Cate and others as having "supportive and shared leadership, shared values and vision, collective learning and application of learning, supportive conditions, and shared personal practice" (p. 88).

Once I had experienced such an educational atmosphere, I was driven to find opportunities to discuss teaching, learning and education, despite being transferred to a school more in line with what some might describe as a traditional school (Cate, et al, 2006; Senge, 2000). "Such schools are places where teachers are isolated and

faculty meetings are infrequent and focused on routine business. Collaboration about teaching practices is left to the discretion of the teachers" (Cate, et al, 2006, p. 88). The professional learning community encouraged me to reflect critically with other educators on my teaching methods and to focus on student learning. The traditional school, which was making strides to provide more time for teacher collaboration, was more focused on the content and the individuality of teachers; there was not an emphasis on collectively improving student learning or teacher practices. As such, I made repeated efforts to collaborate with my colleagues or I turned elsewhere, to colleagues at my previous school, to fill the perceived void in my professional journey as a teacher.

These three areas—use of metaphors, transformative learning, and professional learning communities—appear to be three vital aspects to the changes I encountered during my first few years as a teacher, and to some extent, even today as I write about and reflect upon those experiences. By writing my educational autobiography, I once again can examine, critically reflect upon, and evaluate my perspectives, metaphors, and understanding of teaching, learning, life, and the nature of knowledge. Although some readers might find other themes or aspects of my experiences they think are more meaningful, that in no way takes away from the importance of the stories. In fact, as readers create their own meaning out of my experiences and even reflect on how those experiences fit with their own understandings, it emphasizes the importance of autobiographical research. This type of research allows others the opportunity to construct their own meaning out of the experiences of others, and hopefully, evaluate their own thoughts and assumptions in

light of the author's explanations. As Clandinin and Connelly (1991) state, "Deliberately storytelling or restorying one's life … is, therefore, a fundamental method of personal (and social) growth: it is a fundamental quality of education" (p. 259).

CHAPTER 1

INTRODUCTION

Everyone has a story to tell, but unlike what many people experience, I actually have the time and opportunity to tell mine. I am just an ordinary man with some educational experiences that need telling. Over the course of my seven years of teaching, I have felt a dramatic shift in my perspectives on education and the world; at times, I feel these changes have been radical. The teachers with whom I have worked have also observed my evolution, and they too describe it as being quite drastic.

The changes specifically involve my thoughts about science, learning, and teaching. As an entry-year teacher, I was extremely confident my scientific knowledge was enough to guide my students to an understanding of the natural world, that I could, like Freire describes in *Pedagogy of the oppressed* (1993), deposit information into their minds. The more *I* knew the greater amount *I* could deposit. In fact, when I graduated college, the books that went with me were not educational books, but books about science (Bruice, 1995; Hecht, 1994; McMurray & Fay, 1995; Stryer, 1995). I was convinced that what I knew about the natural world was accurate and valuable; my faith was in my science (Postman, 1992). Being a science teacher was more about knowing science than knowing about pedagogy, psychology, or educational issues.

I also envisioned school as a factory where students would periodically come to get worked on and refined. With students as raw materials, I would have the task of molding them into young adults who knew science (or whatever else was being

taught). The kids would come to class, get chiseled for a time, and move on at the signal of a bell to the next portion of the "factory" to continue the molding process. The classroom and learning were to be efficient and productive; those who weren't willing to be industrious in the classroom would be motivated in different ways to make the learning process more efficient (Caine & Caine, 1997; Callahan, 1962; Taylor, 1911)

In short, when I was launched into teaching, I was adhering to a modernist's perspective of the world and of education (Caine & Caine, 1997; Doll, 1993; Fleener, 2002). As I talked to other educators and gained more experience as a teacher (and as a person), I began to understand more about the roots of this perspective, both culturally and in my own life. I started to question my actions in the classroom and my interactions with others—with teachers, students, and acquaintances. As a result, my views about education, science, and even the world began to evolve and are continuing to evolve to this day as I learn more.

I now have more questions about science and education than I have answers (Bauer, 1992; Brush, 1974; Gould, 1996). I have difficulty seeing my classroom as part of a learning factory for students. I have difficulty with the wave of accountability measures that are forcing classrooms and schools to be efficient—as if genuine learning can truly be measured on a multiple choice test and students can (or should) be accurately measured against one another (Brooks & Brooks, 1999; Hurwitz & Hurwitz in Noll, 2003; Kohn, 1992; Meier, 2000). In general, I struggle with and question the modernist tilt in education today that stresses efficiency,

accountability, and a narrow focus on what constitutes knowledge (Caine and Caine, 1997; Doll, 1993; Fleener, 2002).

Because of this evolution, I was inspired to write my autobiography; without the change, I would have never entertained the idea. As Jean Starobinski (1980) states, "One would hardly have sufficient motive to write an autobiography had not some radical change occurred in his life…" (p. 78). Although I don't feel my experiences are unique or that others couldn't experience the same, stories about science teachers coming to grips with the culture of "scientism" and "modernism" are scarce (Caine and Caine, 1997); I want to share what I, a science teacher, experienced when I understood the foundations of my assumptions about learning, education, and people. The intent of my story is not to convert or to convince others that my way is the right or only way; however, the purpose of my autobiography is actually twofold.

The first is somewhat selfish. This story is a reflection on my part; it will help me refine my thoughts on education and learning (Graham, 1991; Shon, 1983). As Roth (2000) states, "…autobiography has great potential as tool for science education researcher, a tool for helping preservice teachers develop a teacher-self, a manner of growing as a teacher. Furthermore, autobiography has great potential as a means of representing science education research" (p. 8). Writing my autobiography will be an enormous learning process for me (Clandinin & Connelly, 1991; Dewey, 1938; Mattingly, 1991; Millies, 1992). It will also be a document I can look back on and get a perspective on what I thought I knew. When I reread this after I retire and am sucking down margaritas on a beach in the Caribbean, it will be great to get a sense of what my twenty-seven year old self thought was important. It will also be a

document my kids, grandkids, and other relatives can read to see what happened in my life as a teacher, student, and as a learner. Some may even choose to see it as part of my teaching legacy.

The second purpose is to give other educators (and even non-educators, if they exist) a story that may help them understand what one teacher has been through. From my experiences in getting my first job, to my transition from teaching middle school science to teaching high school biology, I hope others will find something within these pages they find helpful and insightful (Mattingly, 1991; Moustakes, 1961). I especially hope my evolution as a teacher and my changes of mindset can challenge how educators see students (Clandinin & Connelly, 1991)—not as test scores, raw materials, or quantitative data in a desk, but as emotional, interesting, and ever-changing lives that desire to have meaningful experiences and relationships. I anticipate during the writing process that my own thoughts and ideas will be challenged yet again.

The idea for writing my teaching autobiography was born out of the comments and encouragement from a professor in a graduate class I was taking in the spring of 2004. At first I thought the idea of an autobiography was somewhat absurd; I was only a twenty-five year old with five years of teaching experience. The notion of me writing about my half decade of teaching experiences seemed a bit conceited; I didn't think I had lived long enough to have a story to tell. I had read several autobiographies of people like Booker T. Washington (1993), Robert Inchausti (1993) and Eliot Wigginton (1985), but these were people who had done amazing things and had incredible stories. They were also somewhat well known and further along in

their lives; I felt like a relatively young nobody whose stories could not compare with the ones I read in these books.

Adding to my doubt was my educational background from undergraduate school. I was trained in the positivist methods of science that focused on hard, proven, quantitative data; science, to me, was static and absolute. There seemed to be very little academic merit in writing an autobiography; an autobiography would be too 'soft' a dissertation topic. The culmination of my doctoral degree would involve quantitative data, number crunching, and time in a statistics book looking for the appropriate equations. I couldn't see how an autobiography would be rigorous enough or important enough for what the doctoral program expected. As Ayers (1992) describes, "Unfortunately teachers' stories are hard to find. They are generally dismissed, even by teachers, even by the storytellers themselves, as personal and unimportant" (p. 150).

When I expressed these reservations to the professor who suggested I write an autobiography, she encouraged me to step out of the positivist box I was used to. She mentioned she had heard of several doctoral students who had done autobiographies for their dissertations; that it was a new idea. But what most influenced me in regards to my doubt about the significance of *my* story was a statement she made while talking to the class as a whole. She stated something to the effect that each of us are hundreds of years old, and we all have a story to tell.

The professor's statement was quite simple, and at first I thought it a bit silly. After all, this professor had taught several other classes I had taken, and she was admittedly at times a few fries short of a happy meal. The students all loved her class

because of the crazy but interesting things that would come up during our class conversations; I thought this was just one of her crazy sayings. But the more I chewed on her statement, the better it tasted. In my short time in the classroom, I had experienced what I felt was a drastic evolution in my thoughts about teaching and learning. What I thought I understood when I began teaching and what I feel I know now are quantum leaps on the educational spectrum. I had good reason to want to tell my story. She and I went on to discuss the idea of writing the story of my teaching and the changes I experienced and still am experiencing along the way.

As we continued to talk I began to realize that although I had only been teaching a few years, my ideas and methods were products of a worldview that had been evolving ever since the dawn of humanity (Mattingly, 1991). I began to see how my self, my thoughts, my beliefs, and my perspectives, were the result of the thoughts, beliefs, and perspectives of the hundreds, if not thousands, of years of human thought. Although I had not directly read or understood most of the thinkers who shaped my perspectives, I had life experiences and encounters with others which pointed me in their direction. My worldview and perspectives did have a foundation; I just didn't know the composition of that foundation.

By talking through my concerns, I realized the reservations I had about doing an autobiography were a direct result of my modernist understanding of knowledge. As Bullough and Pinnegar (2001) explain, "Self-study represents this trend away from modernism and its assumptions about legitimate knowledge and knowledge production toward broadening what counts as research" (p. 13). The trend moves away from knowledge obtained or constructed strictly by using the tools of science.

It broadens the definition of what encompasses 'research' and 'knowledge.' Doing an autobiography was my opportunity to be an archeologist; a chance for me to uncover the collective past of my life and hopefully give me a better perspective for my future.

By changing my understanding of what research and knowledge was, I embraced the idea of writing my story. I interviewed past and current colleagues, students, and friends, and was able to get their perspective on the events they thought helped to make me who I was. I looked at my lesson plans, the notes I made myself throughout each school year as a teacher, and even reread the papers I wrote for my graduate classes. I perused the books and articles I read during my seven-year teaching career and reread the pages I dog-eared, highlighted, or commented on.

I also read books and articles on how to write autobiographies and how to make sense of lived-experiences (Ayers, 1992; Bullough & Pinnegar, 2001; Butt & Raymond, 1987; Butt, Raymond, & Yamagishi, 1988; Clandinin & Connelly, 2000, Eisner, 1991; Franzosa, 1992; Graham, 1991; Kridel, 1998; Moustakes, 1994; Norum, 2000; Olney, 1980; Pinar, 1975; Rainer, 1997; Ritchie & Wilson, 2000; Schon, 1991; Schubert & Ayers, 1992). I immediately connected with Pinar's notion of *currere* because it is often compared to the act of running (Pinar, 1975; Graham, 1991). In *currere*, the focus is not so much on the course or the destination (the objectives and ends) as much as it is on the running or the experiences during the race (the processes and the learning). In doing my autobiography, as in running a race, my focus would not necessarily be on the actual story and its ending as much as it would be about making sense of those stories and lived experiences. Some have even compared this

notion of *currere* to Dewey's thoughts on curriculum as experience, of making sense of lived experiences (Dewey, 1938; Graham, 1991). And although I realized I would never find my *real* historical person of those seven years, I did attempt to focus on the stories and events that stood out and tried to make meaning of them.

This then, is my story—a story of how my attitudes and perspectives on life, learning, and people evolved from a modernist, traditional perspective to a post-modern, progressive/constructivist perspective. Of course, the names of the people and schools are changed to protect their confidentiality, but the events aren't. Although some might question the trustworthiness and validity of an autobiography (see Grossman, 2006), I took great pains to get others' perspectives and thoughts on the stories within these pages. Through interviews with former students and colleagues, through looking back at my notes and lesson plans, and through reflecting, I have collected what I think are the significant and interesting stories about my few years of teaching. I am not naïve enough to think that each of these stories is completely accurate, but they are the best my and my interviewees' memories had to offer. This is my educational autobiography.

CHAPTER 2

TAKING OFF…

If you were to roam the halls of any high school or college and ask the students what they most look forward to in their education, many of them will mention graduation (or some version of "getting out of here!"). It's not the classroom experiences, the textbook readings, or even the extracurricular activities they anticipate; most have their mind set on the end—the walk across the stage to accept the diploma.

I was not unlike many of those students while in college. I eagerly anticipated the day I could proudly call myself a college graduate and take off, like a Boeing 747, into the workforce. The four intense years of reading books, writing papers, and attending science laboratories seemed to be great preparation for a life of teaching science to adolescents. Adding to my excitement about graduation was the promise of getting the ideal science teaching assignment—one in a nice, clean room with the newest science supplies, and students who were eager and ready to listen, learn, and study. After all, as a college graduate I would have spent the last four years of my life learning in-depth about biology and chemistry, subjects upon which my undergraduate college prided itself. In fact, one of the main reasons I chose the university was its reputation among medical schools for preparing future medical students. There was an immense sense of pride when walking across campus with the title of "pre-med," a title I held until my sophomore year when I decided to pursue science education. The promise of a good salary (by a college student's standards) and no homework were things I looked forward to, especially as the senior year drew

to a close. While attending college, I worked for about seven dollars an hour at a small airport doing odd jobs like detailing helicopters and fueling aircraft; I couldn't wait to graduate and start making a living doing what I had been trained for—teaching science.

However, one of the things I did not anticipate was the disappointment I would experience that first summer out of college. After returning from my honeymoon, I quickly set out to find a job teaching. During this search process I decided to provide financially for my new bride by working for a little less than seven dollars an hour at a home improvement store with the intention of landing that dream job and ditching the hardware department. I was a bit humbled taking a full-time job at a home improvement store making less per hour than what I was making in college working part-time at a small local airport.

As I filled out school district applications and worked odd hours selling nails, stocking shelves, cutting house keys, and sweeping the aisles of my work area, I began to question the prospects of actually getting a job at any school. By mid-summer I had only had two interviews, and the only promising one was with a school for students who were unsuccessful in the traditional school settings. At this school the resources available for a true science classroom, one with beakers, graduated cylinders, compound microscopes, and dissecting supplies was scarce to say the least. I could not imagine myself settling for a job that offered students so little of the science to which I had become accustomed. I had come from a college that took pride in the value of science to the world and it seemed as though this small, non-traditional school was short-changing what I cared so deeply about.

I had partially felt this same frustration with this disrespect for science during my student teaching experience in a small rural school, and could not imagine teaching science with even fewer resources. As a student teacher, I was assigned to teach two sections of biology and two sections of human anatomy. My supervising teacher was a great man who was in charge of the high school science department (which included two other science teachers). Although his knowledge of science was adequate, as I observed him that first day, I felt what I had learned the last four years in college could really help these students understand and appreciate biology and the human body more than what I thought they were experiencing; I knew I had something more to offer.

During my time at the university I had taken advanced courses that went into great detail about the human body, both the structures and the processes; I had memorized the steps of complex biochemical processes such as DNA transcription, DNA translation, and protein synthesis; I could even give the scientific name of several of the plants, trees, and flowers on campus. By understanding these and other scientific advancements, I considered myself several steps ahead of most teachers. It was though I found my identity in what I knew about science and in my thoughts—just as Descartes uttered in the 17th century, *cogito ergo sum*—I think, therefore I am. In fact, my mindset could be explained as one similar to the "scientism" or "scientific hubris" Postman describes in *Technopoly* (1992). "The successes [of the natural sciences] have attached to the name of science an awesome measure of authority, and to those who claim the title 'scientist' a similar measure of respect and prestige" (p. 159). I figured the students would respect my authority as a teacher because of my

knowledge about science and that my understanding of the natural world was sufficient to gain the respect of my colleagues.

Adding to my confidence was what I perceived about the content being taught at the rural school where I was student teaching. While observing my supervising teacher that first day, I could confidently say I knew more about the processes he was discussing than the description in the students' textbook. I felt because of my knowledge of the subject, I could deposit large amounts of information into the minds of the young adults seated in front of me (Freire, 1993).

Because of my faith in my scientific knowledge, I took off with one of the classes and began teaching them on my second day. Within a few more days, I was in charge of all of his classes; I was taking off into teaching.

Having watched my teachers both in college and in high school, I took it for granted that educators would have adequate supplies at their disposal, especially in science classrooms. Unfortunately while doing my student teaching, I had very few supplies with which to work. I had never imagined a school being ill-equipped with the supplies and resources needed for teachers to do their jobs. Although this particular school was not as unfortunate, I couldn't envision schools existing in the dilapidated way Kozol describes in his book *Savage inequalities* (1991). I never experienced such a lack of resources in schools; I was surprised to find it during my first teaching assignment.

I was so desperate for supplies that I had to ask my college professors for overhead transparencies of things such as the human eye and the human brain. Luckily I was able to acquire two folders full of science transparencies; I used these

frequently, and in fact to this day still have those two folders. Needless to say, the storeroom was also lacking in things like microscopes and slides, things I could not imagine doing without in a high school biology class. In fact, I don't remember seeing a single microscope in that small five-foot by ten-foot supply closet.

Despite lacking many of the supplies I would have hoped for, I did try a couple of labs that required minimal equipment, but there was one that really put a damper on my future attempts to try labs in *this* science classroom. The classroom was a large rectangular room with desks at one end and a mini-lab at the other. There were no windows, but there was a large mural of dinosaurs along one wall that gave the appearance of having a view to Jurassic Park. The high school was a two-story building with the lower level being a basement. The two science classrooms were located in the basement, without a window to the world and without a vent to exhaust nasty science smells.

About halfway through my semester of student teaching, the topic of nutrition was to be taught, including the concept of the "Calorie." A calorie is simply a unit of energy; more specifically, it is defined as the amount of energy it takes to raise one gram of water through one degree Celsius. Take 1,000 of these calorie units and you would get what is found on food labels—the kilocalorie or simply the Calorie (the capitalized "C" in text turns one calorie into 1,000 calories). To get my students to understand how this concept related to the foods they consume, I had them bring in various foods that could be burned—most were surprised when I told them many foods would burn in a similar manner to matches. In this lab exercise, we burned these foods and tried to determine the Caloric value in them (for a summary of the

lab, see Anytime Anywhere Chemistry Experience, 2000). As you can probably foresee, this was not the greatest lab to do in the basement of a poorly ventilated high school. Although I was confident in my content knowledge, I was quickly humbled that day on my understanding of what a considerate science teacher and hallway neighbor was all about.

The students brought in foods ranging from potato chips to peanuts. We set up the small lab by filling emptied aluminum pop cans with a set amount of water (a mass such as 50 grams) and taking the initial temperature of that water in degrees Celsius. We then put the food under the can and set it on fire. As the food burned (and did it ever burn) some of the heat was transferred from the flame to the water. Once the burning stopped (which takes several minutes, especially in fatty/greasy foods) we recorded the temperature again to determine the change and calculate how many Calories the food contained (a very rough estimate). What I didn't anticipate was the smell of burnt food emanating from the classroom lab, out into the halls and eventually out of the basement and up the stairwell. As class was dismissed and students began moving about the hallway, I quickly realized the disadvantages of not having a fume hood. Immediately there were comments about the stench in the building, which continued throughout the entire day—both the comments and the stench.

Although most teachers appeared sympathetic to my situation, I'm certain they could not believe I would try such a thing, that I didn't have enough foresight to know this was going to happen. I was more than likely the punch line of several jokes that day, but I quickly learned the advantages of having the proper lab set-up.

Although the lab experience seemed to bomb, I learned to look beyond academic outcomes in the lab. As Robert Inchausti (1993) states in his teaching autobiography, "The problems of today invent the lessons of tomorrow" (p. 27). Like the smell of burnt popcorn, that lab experience was one that will not easily escape my memory, but it was a great educational experience; one that allowed me to look past the educational outcomes of activities and consider how things might go awry.

Doing without many things during my student teaching, although a valuable experience, was not something I wanted to repeat if at all possible. I never thought I was offering those students in that small rural school the "true science" I had learned in those four years of college—a science that measured the mass of objects precisely with electronic balances, that made use of recent computer technology to communicate scientific ideas, that made use of tools other than pencil, paper, and textbooks. I wanted to offer my next students something closer to what I experienced while in college; a science class closer to what I thought science was supposed to be—a science without the smell of burnt food. So, I decided to decline the position at the non-traditional school with the hopes of something else opening up later that summer.

Soon after I decided not to take the job at the non-traditional school, feelings of frustration began to set in. I had spent four valuable years of my life learning some of the best information I could imagine, and I was stuck in the hardware section of a large home improvement store explaining to do-it-yourselfers the advantages of a galvanized 8-penny nail over the non-galvanized type. My science knowledge was

going to waste. Arrogantly, I felt as though schools were making a mistake by not giving me a chance.

The frustration grew as the summer drew to a close and I still did not have a teaching job; I began thinking about the long and difficult upcoming year as a hardware sales associate. Then, the unexpected happened.

It was a Sunday morning and I was working the morning shift in the hardware section while my new bride was at home, spending a nice summer morning without me. This added to my frustration until I noticed a customer in the hardware section proudly wearing a shirt from a local school district I had applied to months earlier. I struck up a conversation by asking if I could help with anything. He informed me he just changed jobs from an administrative post down south to a principal's position at the school to which I had applied (hence, the shirt); he was looking for some supplies to install a storm door on his new house. As we discussed his hardware needs, I cautiously mentioned my career needs. I informed him of my desire to be a teacher and my frustration with not even getting a chance at an interview. In a way it was similar to trying to find a vent for burnt food; I just wanted some educator to listen to my frustrations. Fortunately, he was willing to listen and by the time we were finished getting his supplies, surprisingly he had agreed to talk to some of the people at his new school to see if there were any openings—a small chance since school was only weeks away from opening. But that small chance was more than I had seen most of the summer; all I wanted was a chance to show them what I knew, a chance to show someone what I could do in a classroom. From that unlikely encounter in the hardware section on Sunday morning, the figurative ball started rolling.

CHAPTER 3

…AND LANDING THE JOB

A few days after the chance encounter at the home improvement store with the principal, Mr. Fulton, I received a call from the school about interviewing for a position teaching sixth grade science. Coming from a college that placed a tremendous amount of pride in its science program, I naively felt my skills would be better suited for a classroom that could look at science more in-depth. Although I wanted to teach high school and confidently assumed a job at the high school would be better for me than a job teaching sixth grade, this job was something I could do. After all, I knew enough science to make those sixth-graders' heads spin.

Looking back on my encounter with Mr. Fulton in the hardware store, I am surprised he remembered, much less mentioned my name to his colleagues. I can't imagine the risk that principal took telling his fellow administrators he wanted them to give a home improvement store associate a chance at teaching in their school. But he did, and now I had my shot to get into a teaching position before school began.

I didn't prepare much for the interview. I guess I should have learned the importance of that somewhere in my schooling, but I go in with only a pad of paper, pen, and my resume. But there are a few things I do that I believe make a difference for me. First, I go in armed with a list of questions, because invariably at the end of the interview, they ask if I have any questions. I don't want to give the impression that I have not thought much about the job. Asking them questions not only allows me to appear interested in the job, but it also gives me a chance to feel out the school. If there is ever time for questions, I ask something. I think it makes a difference.

But, I suppose the one thing I work on most before I get to the interview is my appearance. I dress the part and hope the questions they ask will fit with what I know. While I was growing up, my dad frequently talked about a book *Dress for success* (1975) and how there were things you can do with your wardrobe to make a difference. Like any son, when he would talk about things I didn't think were important, I would nod my head and try to let all the information pass into one ear and out the other. But somehow, bits of his wisdom apparently found a detour along that route and into my long-term memory; I now think appearances can make a difference, especially in an interview. Ironically, it seems I am similar to a lot of my students—not caring overly much about the grey matter between my ears, but instead worrying about how my outward appearance can impress those I encounter. In a way I suppose if the interviewers ask questions I cannot answer well, then the job was not meant for me.

I don't recall much about that interview. Many of the questions asked seemed commonplace for a teaching position. The interview was somewhat relaxed, and I felt comfortable the entire time. However, there was one exception. There was one question I did not expect, and it is one any prospective teacher should anticipate and be able to answer when being interviewed, especially if they happen to be a male. As the interview was winding down and I had answered their questions about academic material, the principal of the middle school (who was not the same principal I saw in the hardware section; I would not deal much with him until years later) asked the question—"What about coaching?"

I remembered back from my time in college to the day I told the pre-med advisor I was going to pursue teaching instead of medicine. He was a man who garnered great respect among his colleagues and students; he was the epitome of science to many. Most, including myself, felt intimidated by his stature and his status on campus. He was an older gentleman who weighed over 250 pounds with grey hair and a beard. The words he spoke seemed calculated and direct. Although I was hesitant to tell him about my decision to go into teaching, I felt I needed to let him know. He pondered my statement for a short while then began probing me about my decision. One of his questions was about being a coach. Actually, it was phrased as a question, but I could tell it was a statement. He asked if I planned on being one of "those coaches." That day with the father-like figure I literally had no interest in coaching, so I made those intentions known to the professor. I told him my desire was to be a teacher not a coach; he seemed pleased to hear that answer.

But now, in the interview, the coaching question had more riding on it. It wasn't simply a philosophical choice I could make in a professor's office. It was a decision that might determine my ability to support my new bride and start a career in education. Although I never anticipated being a coach, it was a role I thought I could play. I also anticipated that it might give me an advantage over the other applicants; I couldn't imagine the others applying for the job being much more qualified than I was seeing how the start of school was only weeks away. Reluctantly I told the interviewers I would be willing to coach as long as they understood that teaching was my primary responsibility. They agreed that teaching should be my primary responsibility, and I was encouraged by the discussion we had about coaching.

Although I didn't have any teaching experience (other than my student teaching), I was confident about my credentials and left the principal's office feeling quite good about my chances.

A few days after the interview, I received the call all new graduates long for—the call to ask if I would consider taking the position. It seemed the coaching answer played in my favor as they also told me about a position that was open coaching eight grade boys' basketball. I'm not sure if the coaching was what tipped the scales in my favor, but I agreed to try it for a year. I was overjoyed that I would finally have my chance at teaching. My wife shared in my excitement and I made arrangements to cut back my hours in the hardware department, and eventually hang up my hammer when basketball season began.

CHAPTER 4

BEGINNING TO LEARN

The joy I experienced the days after the phone call from the school was quickly tempered by the stress that accompanies a new teaching job. I had never begun a school year with my own students, in my own classroom. What in the world was I to do the first day? What was I to accomplish in the first week? What kind of science do sixth-graders learn? What am I to expect of them? I had focused much of my efforts in college on learning the science and preparing to teach high school; I really thought I would be teaching eleventh- and twelfth-graders, not teaching eleven and twelve year olds. Even with the uncertainties I felt about teaching such young students, I always was comforted by the science I knew; after all, I was still a *science* teacher no matter what the age of the students.

As a way to help incoming teachers, the district required new teachers read Wong and Wong's book *The first days of school* (1998), which gave suggestions on how to begin school, both as a new teacher and as a seasoned veteran. Because I had so much respect for the district's reputation as being one of the better school systems in the region, I thought there would be great reason to read and apply the book to my classroom. Also, I had never conceived of a classroom before; I had never *begun* a school year as a teacher. My teaching experiences were limited to environments where the classroom system was already in place; I didn't have much knowledge about how I should begin setting up my classroom. Although I didn't do all Wong and Wong (1998) suggested, I did take away one major idea about how I wanted to arrange my classroom; it can be summed up in one word—*procedures*.

Throughout the book, they advanced the idea of having clear classroom procedures to curb many of the problems that teachers face, from students' talking to turning in homework. I also talked to several teachers I had met and gotten their ideas on how to design a classroom and how to begin the school year. From what I could gather, the best way to begin the year was to describe the procedures I expected out of the students and to practice those for the first couple of days. I was also encouraged to continue using and following those same procedures throughout the remainder of the year.

As I began to ponder the procedures I wanted to use in my classroom, I doubted if they would actually work like Wong and Wong described. It seemed like such a simple thing to just have a procedure for the things done in your classroom, but I wondered if it would work in *my* room. I didn't want the students to see through my insecurity, so I began with a few procedures I thought would be easy to put into practice. Although I didn't use many procedures during my student teaching, I drew on the experience to determine what I wanted to implement.

While student teaching, it was so frustrating for me to take attendance during the first few minutes in class. The students basically had a social time while I checked to see who was not in his or her desk. Several students would roam around the room, talking with friends who were not seated near them. Although they were supposed to be in their seat while I was taking role, if I were to get onto them they would always have some excuse; there was no accountability. It just seemed like I was not in control of the classroom during that short time at the start, and it set the tone for the remainder of the class period. I wanted to have those first five minutes

structured and productive, so I tried a procedure many of my colleagues actually did (something I was unaware of until several weeks into my teaching).

I decided I wanted to begin class everyday by having the students answer a journal type question I had written on the board. It was not a particularly difficult question, but it was one that would require them to do some individual work. While the students were answering the question, I would be given the chance to do "teacher housekeeping"—things like passing back papers, taking attendance, getting notes to students, and taking personal time for me between classes. Although I never observed any of my former teachers do this, it sounded like a great plan to be more efficient and manage what my students were doing. So I decided I would describe and implement the journal beginning on the first few days the students had my class.

The first day of school for most teachers is usually a meet and greet session, and I am like most teachers, I imagine. I didn't want to begin the year with a list of procedures, so my first day with those sixth-graders was spent by doing the standard introduction about myself and assigning students to their seats. Although I was extremely stressed and anxious, I tried not to let it show. In fact, I may have gone a bit overboard trying to cover up my doubts and emotions. I heard from several other teachers (my dad, grandfather, and grandmother to mention a few) that I shouldn't smile until Christmas break. As a new teacher, it seemed like a good way to show who was in control of the class and to demonstrate comfort with my position of authority.

Being a first year teacher, one of my greatest fears in the classroom was not about how my students would be learning, it was how my students would be acting;

apparently, I was not alone in these fears. As Wigginton (1985) states in his teaching autobiography, "During my first year of teaching, I was often preoccupied with the chore of keeping students quiet, in their seats, and on task. I felt that my reputation among my peers and the administrations depended greatly on my ability to do this. I spent more time fretting over eruptions than on the job at hand" (p. 247). Inchausti (1993), in his teaching autobiography, devotes many of his stories to describing his bouts with unruly students and the insights he gained while trying to get control and respect in his classroom.

As a new teacher, just like Wigginton and Inchausti, I tried to determine the best ways to limit the number of student discipline problems. I determined to take the advice of my relatives; not smiling was an easy way to get control and to relieve some of the stress of having rambunctious students. If I came across as being too nice, I would get trampled those first couple of days, and I figured it would be very difficult to establish my authority if I didn't get it those first couple of days (see a discussion of "control" and "authority" in Kohn, 1993; 1996). By not smiling, I would send a clear message to my students that I was in charge and that I meant business. So as I talked to my new students that first day, I did my best to be as stoic and firm as I could. I did not let them know I had an emotional side. In a way, I was mirroring what I saw in the revered science professor from my undergraduate school. I wanted my students to respect and even fear me.

That first day came and went without much difficultly. I did, however, get a chance to assert my authority when I observed two of my students actually getting inside their lockers like they were clowns getting into a Volkswagen Bug during a

circus act. Firmly and quickly, I explained how inappropriate that was for sixth-graders; they were no longer in elementary school and needed to mature beyond the games and antics of those earlier years. They responded as I had hoped; they apologized and swiftly went to their next class, books in hand, like miniature high school students. Compared to teaching in high school, I was amazed at how easily the students were agreeable to my demands. Through this incident and what I observed in my class I felt as though the students respected my authority. When the last class ended that day I pondered the first day in *my* classroom; my confidence level increased as my fears about not having control faded.

Up to this point, I spent my evenings at home trying not to worry too much about what I was going to do in class, but it didn't help. I would lie awake at night trying my best not to think about school, but that was all I *could* think about. I naively imagined that after graduating from college I wouldn't have any schoolwork to do while at home; now it seemed worse than I could have ever imagined. I couldn't help but think about what I was going to do the next day in class. No matter how much I prepared at school, no matter how much I planned the following day's events, the work would follow me home. My mind would create an imaginary classroom and I would deliver the lesson several ways, trying to determine which one would be best. No one had ever warned me of this, and I felt some degree of self-pity as I saw my non-teaching friends on nights and weekends not having a care in the world. I wondered if I was unique in the world of first year teachers. This agonizing would continue throughout the entire year, but it did get less severe as the year went

by. I had not anticipated the amount of time my thoughts would be focused on my classroom.

When I arrived early for the second day of school, the feelings of anxiety and stress still found their way into my classroom. Much like what Inchausti (1993) describes, I felt weak before school began. He describes, "Each day now, about two hours before going to school, I felt a hollow terror in the pit of my stomach and my arms felt strangely light, as if beginning to disconnect from my body" (p. 12). Although I felt confident about my first day, I was still concerned that a student would challenge my authority. I knew my science, but I was unsure about how to handle a brave and cavalier twelve year old. I suppose this is one of the ironies of being a teacher. A person could have all the science or mathematical knowledge available to humankind, have more degrees than a mercury thermometer, yet still be humbled by the words of an early adolescent. I went over my day's plans several times that morning. I didn't want to miss a beat during class so I made list after list of what I planned to talk about that second day, but the lists could not take the place of actually doing it. By the time the first class started, I had done all the preparation I could do.

I began that second day by talking about what the procedures would be for my class. I explained how the class would begin the same every day—with them answering a question in their journals. We actually took a good chunk of class time that second day entering and reentering the classroom, practicing the procedure. As they entered the classroom, the students took out a piece of paper, wrote the date, and copied the question word-for-word from the board. They then went to work

answering the question individually at their desk, without bothering those around them. The students practiced this routine at least five times that day just to make sure everyone knew what was expected. As I observed the students coming into class over and over again that day, I stood amazed at how smooth and efficient it all seemed. I even remember uttering under my breath, "It actually works!!!" The students came in, grabbed a piece of paper and pretended to be writing out the date, question, and the answer to the question on the board. Wong and Wong's idea seemed to be working for me.

The next few days of class continued with few, if any, problems. We were practicing the procedures and the students were doing them more efficiently and more organized than I expected. Now the task of teaching science began to take center stage; something I eagerly anticipated. As I looked through the teaching materials and ancillaries the school supplied, I was surprised at how much I *didn't* like the suggestions of the teacher's edition to our textbook. Part of my disappointment was probably due to my expectations of the depth of science I would be teaching. Nonetheless, I did find one assignment I thought would be a good beginning project for them to complete—the mystery box (for a description of the lesson see *Science Horizons*, 1993, or LessonPlanPage.com, 2005).

A mystery box is simply a closed container that has different objects inside, both attached and unattached. An example might be a shoe box with rows of drinking straws taped to the inside of the box with a ping-pong ball inside to make a sound as it rolls across the straws. One of the challenges is to determine what is inside the box without opening it up. The students would have to shake, rattle, twist, listen, and feel

their way to an understanding of what lies inside. I assigned everyone the task of creating his or her own mystery box at home and then turning it in so I could use them in class to test their senses and their imagination. Although this activity would have been great to use during a more in-depth discussion on the nature of science, I limited our use of the boxes to show how scientists use their senses. Admittedly, I could have used the boxes for so much more (Evolution & the Nature of Science Institutes, 1999), but I honestly felt most comfortable talking about how we use our senses to know the world; I was not willing to enter into a philosophical discussion about the nature of knowledge and scientific investigation (in fact, I'm not sure I knew enough about the nature of science to see much more of a connection between it and the mystery box).

The students thoroughly enjoyed doing the activity and trying to guess what was in their peers' mystery boxes. One of the best parts was when we actually opened the boxes to uncover what they had known only by using their sense of feeling and hearing. They were quite shocked to learn about the "real" contents of the boxes. (If I were to do the activity again, one of the things I would consider doing was *not* opening the boxes. This would let the students understand what many scientists feel when doing research.) The class discussion of senses and how scientists use those senses was interesting when used in the context of the mystery boxes. I challenged my students to try to perceive the world more closely, to examine things using more than just their eyes.

When assigning and deciphering the contents of the mystery boxes in class, I didn't imagine the name "mystery box" would stick. But I had one particular student

who was learning disabled, and he seemed to really like the sound of the phrase "mystery box." After those first few weeks, almost every time we saw each other, those words would come out of his mouth and his face would light up with excitement. He knew my name, yet would often acknowledge my presence simply as "mystery box," a name I didn't mind him calling me. Even several years later, when we would pass each other in the halls or at a school event, those words would come repeatedly rolling out of his mouth—"mystery box, mystery box, mystery box."

Although the mystery box was a great activity the students enjoyed, I began to understand for myself one of the great challenges in education—evaluating a student's work. In grading the boxes, I wanted to develop high expectations of what *my* students did with their science work; I did not want my assignments to be "easy A's." So as I set out putting numerical grades on the boxes, I didn't want to give anyone a perfect score. I didn't have an objective rubric I used to determine grades; I simply looked at the boxes and used my professional knowledge to put grades on the projects. The highest grade earned was forty-nine out of fifty, a ninety-eight percent.

This particular box seemed somewhat simple, yet I could not figure out what was in it. I manipulated it for several minutes, trying to determine what it could be. The only noise it made was when it was turned on either end. It was a noise similar to a broom slowly and softly brushing against cement. It was also relatively heavy; I was stumped. Finally, I gave up and looked inside to find an unused roll of paper towels with a "D" battery tucked inside the roll. The shoe box didn't allow the paper towels to move, but added weight and support for the battery. The battery only

moved when the box was twisted along the line of the paper towel roll. It was a simple, yet deserving box.

When I handed back the boxes with the scores on them, students began to ask what they did wrong to get points taken off of their assignment. I confidently responded to those questions by citing things such as "It could have been neater," "You could have used better materials," or simply "It could have been better." I had in my mind what a good box should be, like the paper towel and battery box, and I wanted the students to understand that I was the authority in the classroom. However, in the back of my mind I started to question how I graded the boxes. I wondered if I could defend myself if a parent called and complained about the grade. Despite my doubts, I stuck to what I believed. I was the science teacher and I wanted to maintain high expectations. I didn't receive any parent phone calls, but from that point on, I started to mentally create rubrics for the assignments and projects that students turned in.

As the year continued, I started to look at assignments in terms of numbers. I broke each assignment down into pieces, and then assigned each of those pieces a point value. I would have loved to just look at the work the students turned in and put a grade on it, but to survive the gauntlet of student and possible parent questions, I had to be more objective in the way I evaluated their work. I never learned how to objectively quantify student's work, but I had to do something that would appease those who might ask questions. It took considerable chunks of time and mental effort to quantify the assignments I gave the students, but I needed a clear and precise way

to grade their work. With more practice, I began to feel more comfortable about it. I also benefited from the help of the teachers with whom I worked.

CHAPTER 5

LEARNING FROM TEACHERS

During my first year of teaching, I was assigned a mentor teacher to help me get comfortable with teaching, and to walk with me during that difficult first year. I don't know the experiences other teachers have had with their mentors, but mine was a tremendous help to me that first year. She was a veteran teacher who had a thick Welsh accent (many times I joked with her about her funny British accent, upon which I was quickly corrected about the accent's origin). I admired what she did in her classroom. She had very high standards of professionalism and most importantly, she gave me lots of useful handouts and activities I could use in my class. She was trained as an elementary teacher, and I was somewhat surprised at how much science she actually knew. She did, however, ask me many science questions, which boosted my confidence and allowed me to give something to her in return for all the things she did for me.

We talked one to two times a week. I would usually come by her classroom with questions about how to teach a certain topic. Most, if not all the time, she was patient enough to dig through her files and discuss how she taught the topic. Other times she would steer me in the direction of other teachers who had resources to help. I cherished the time we spent together talking about the curriculum. I wondered why teachers did not talk more often.

During my student teaching, my only educational discussions were with my supervising teacher; I was never sure why he didn't ever collaborate with his colleagues on topics related to science and education. Compared to what I was

experiencing teaching sixth grade, my student teaching of six months ago was wrought with isolation—an isolation that hinders growth. As Schmoker (1999) describes, "teachers, the front line in the battle for school improvement, are working in isolated environments that cut the lifeline of useful information. Such isolation thwarts them in developing common solutions through dialogue. Isolation tacitly assumes that practitioners have nothing to learn from each other" (p. 10).

After getting a taste of working together on curriculum issues with my mentor teacher, I craved talking with other educators; I saw benefits for not only me, but for my students as well. By so doing, our pupils would be able to realize the talents and gifts of several teachers, not just one. I felt connected during those times where I was able to discuss curriculum issues with my mentor. Wigginton (1985), in his teaching autobiography, sees these networks as vital in preventing teacher burnout. "First, they [teachers who know how to avoid burnout] build relationships among their peers, fighting isolation with as much strength as they can muster, knowing that such networks are their life-support systems as well as their sources for new ideas and input" (p. 283). By being connected with my peers, I felt I wasn't alone in my struggles to help my students learn.

Despite my feelings, however, I was uneasy about asking too many questions; I was not willing to commit one-hundred percent to the idea of asking for help. It was though my questions and my desire to collaborate would reveal my insecurities and uncertainty about my abilities and talents as a science teacher. If I asked other teachers questions, I would be letting them know I was unsure about my knowledge of science and of education. Sadly, this relative isolation and insecurity I felt during

my student teaching and first full year of teaching is more in line with the reality most teachers face. As Schmoker (1999) explains, "An irrational and indefensible isolation continues to prevent professionals from learning from each other. The bottom line is what kids continue to miss out on is a result" (p. 11). Even though I knew my students would benefit from my collaboration time with other colleagues, I couldn't muster up the humility to make it a consistent part of my classroom preparation. I was also unsure about how the other teachers would perceive my desire to collaborate; I was concerned they might not have a reciprocal desire to talk on a consistent basis.

In all, there were about three other science teachers I could call on to help me teach those sixth grade students. Even though I didn't like the idea of asking for help, I ended up at their classroom doors more and more frequently as the year progressed. I don't know if they ever got sick of seeing my face, but honestly, they were my life vest that first year. I could not imagine trying to teach without the resources and encouragement from supportive colleagues. In fact, I don't think any university curriculum or teacher preparation program can completely prepare a teacher for their first year in the classroom. The day-in and day-out need for student activities is overwhelming. By having fellow teachers who were willing to help me, it took some of the stress and pressure off of me creating my lessons *ex-nihilo*.

These teachers were also able, to some extent, to help me relax about teaching; they helped me not take myself so seriously. At one particular science meeting, I walked in and saw the sixth grade department head drinking from a beaker that contained a frothy, yellowish liquid. It was about the color and consistently of

urine. There was also what looked like ticks in the mixture. As she was leisurely drinking from the beaker, I asked her what it was. Without a hint of sarcasm, she talked about her trip to the sewage treatment plant and how she learned all about the city's treatment of our waste. She went on to discuss what her students thought about the contents of her beaker. I was surprised that she would joke about those sorts of things with her class. It seemed a bit crude to me, but admittedly I was laughing out loud at her story. During the whole conversation, she never said what was in her beaker. I imagine some of her students may have thought their teacher was actually drinking human urine, but I am convinced to this day that it was some form of Mountain Dew mixed with raisins, although I have yet to find out what it really was.

Even though the science department was great in helping me teach science, I didn't depend on them to help me with the day-to-day grind of education; I went to my "team" to get help with that. A "team" in my particular school was a term used to denote a group of teachers who shared the same group of students. The team consisted of four core teachers (math, science, history, and language arts) who had a daily common plan time devoted to discussing team issues, such as interdisciplinary units, student achievement, and student discipline to name a few (National Middle School Association, 1982). Excluding my mentor teacher, I learned more from my team that first year than I did from anyone else. If the science department was my life vest that first year, these three team teachers were my personal Coast Guard.

From the moment I began that first year all three of these women on my team were willing to help. Collectively, they had over fifty years of teaching experience; for a new teacher, this seemed to be the ideal environment to begin teaching. We met

almost every school day for at least thirty minutes and talked about students, the school, education, and whatever else was pressing. At these meetings, I was free to ask for advice and get help with things I found difficult. However, at the beginning of the school year, I was somewhat reluctant to ask many questions. I didn't know the personality of the teachers and how they would respond to a first year teacher taking up their time. I was also a bit intimidated to be honest. I had heard many great things about this school district—the great teachers, the great extracurricular activities, the great students; I assumed each of these teachers would be the same—great. Although this might sound absurd to some, I thought most, if not all the teachers in this district would be outstanding educators. As I got to know them, I soon learned that although they were very good at certain aspects of teaching, they were not the perfect teachers I had envisioned. There were things they did which did not fit into my views of how teaching should work.

For example, one of the teachers was prone to use vulgarity during class. The students loved her class and her personality, but I would hear stories from students about how she had slipped up and said a curse word. To many of the students this was great. To actually hear a teacher accidentally dropping four letter words in class must have been a great excuse to drop a few of their own. For me, I could not imagine using that language in a classroom full of high school students, much less sixth-graders. Despite her occasional use of questionable words, she was one of the most creative teachers I ever met. She was able to inspire her students to do great work; even to this day I admire that about her.

There was also speculation about one of the teachers talking negatively about other teachers during class. I was never able to confirm this story, but as I talked to these teachers recently in interviews, one of them told me about conflicts that were occurring that year. At the time I was unaware of any tension among the three of them, but apparently, there was a small battle raging over seemingly menial things. I was not able to gather much information during my interviews with these teachers, but two of the teachers did comment about the disagreements that were happening beyond our meetings; disagreements that were intentionally kept out of my earshot.

I don't know if my naivety kept me from knowing what was going on, or if they were just that good at hiding their squabbles, but I never had any clue there were such deep feelings among the three of them. Even during our team meetings, I was not privy to any friction among the three of them. Fortunately, I was never involved in any of the disagreements; they were polite enough to exclude me from that aspect of education. But according to Schmoker (1999), disagreements are quite common when teachers are expected to collaborate on a consistent basis; something he calls the "dark side of collegiality" (p. 15). Schmoker explains, "Similarly, many teachers find their first attempts at collaboration clumsy and unrewarding. Subsequently, the time they spend in meetings appears to take away from lesson planning and instruction" (p. 15). Despite the disagreements happening on the team, I thought we were able to function quite well. The time together seemed productive, partly because I never had the opportunity to collaborate before; it was my first experience from which to draw (I would learn within the next few years how much more powerful teams could be when I switched to a team that actually enjoyed each other's

ideas and presence; they took the idea of collegiality seriously and were able to do more for students and for each other).

Of the three of them, however, one was able to meet my needs better than the other two. With kindness and generosity she was consistently able to offer her insights and share her experiences in education to help me out. She had taught sixth grade science the year before, and had a wealth of knowledge. In fact, at the first of the year she frequently offered to lend a hand instead of allowing me to make the first move. To some, this could seem intrusive, but it was what I needed. I didn't want to seem uncomfortable or ignorant in my knowledge of teaching science, and so I didn't want to ask many questions about how to teach. Her nurturing suggestions and advice were a great compliment to what I was learning from my mentor teacher. In effect, I had two mentor teachers, both of whom were excellent.

This collection of teachers (the team and the other science teachers) created a good blend of things I admired and things I disliked in teachers. I was able to look to the good aspects of their teaching for inspiration and motivation; they were a model for what I wanted to do in class. When I needed to improve my creativity, organization (including having better classroom procedures), and rapport with the students, I was able to look to them as a model and for advice on how to accomplish this.

Those things the teachers did that I disliked were also good characteristics to observe; it made me aware of the way I did not want to teach and interact with my students. I didn't want to create an unprofessional atmosphere where curse words and gossip were accepted. I wanted to maintain an exemplary integrity for my students;

in a way I wanted to be a model to my students just like some of those teachers were a model to me. I didn't like the way some of the teachers couldn't seem to control their students; I didn't like the way some of the teachers wouldn't actually teach, but instead have the students watch videos or otherwise go crazy in the classroom. I wanted to emulate those who were able to control their classroom; I wanted to have my students pay attention to my lesson the way their students listened to their lessons. I wanted to make sure I could be proud of what I gave my students if they were to emulate me like I emulated some of the other teachers.

However, when I started teaching sixth grade I wasn't certain if any of my students would admire the things I did. During my student teaching there seemed to be nothing the students admired about teachers, including teachers fresh out of college. The students appeared to be set in their ways (either that, or they were extremely good at hiding the fact that they do admire teachers, which is what I choose to believe). It was almost as if the students were more interested in impressing each other than with trying to model some 'green' teacher. Inchausti (1993) describes his experience in terms of the discipline problems he encountered teaching in high school. His first few weeks were fine, no serious disruptions; it was as if the students respected his views and possibly even could relate to him. But as he explains:

> My teacher's honeymoon, however, didn't last very long. About the third week, things began to unravel. I realized this when Marlowe Lakes tossed Marty Shuster's book bag out the window. Cliques were forming. They were beginning to abuse one another and to make fun of the weaker kids. Even James Bailey, the pride of the debate team, was late three days in a row.

> Slowly, all the fragile conventions and class rules I had managed to put into place were being challenged. (p. 11)

With these sixth-graders, however, as the year progressed I began to sense some of them were looking to me for a model of their own. It began to sink in as I started seeing my students imitate some of the things I did. For example, during a conversation with a parent, she showed an unusual interest in my hair and mentioned her son was trying to get his hair to do what mine did. I was surprised to learn my hairstyle was something a student wanted to emulate. A student also asked me where I got my shoes; apparently, he wanted some of his own. I realized these students did see teachers as role models. I imagined myself as a role model for my students, something that never happened to me during my student teaching. Even to this day I try to see myself as a role model, whether it is actually true or not. It is just a great way to live life.

CHAPTER 6

THE SCIENCE OF TEACHING

As that first year progressed, I began to get more comfortable with the teachers and the students with whom I worked. I was seeing firsthand from my team the value of being an energized teacher (i.e., one who smiles with the students). However, I was still cautious about being too relaxed and comfortable with my students; I did not want to lose the control I had captured during the first few days of school. I also wanted to maintain a sense of professionalism in my classroom; after all, I was teaching one of the more difficult and important subjects—science.

I also was getting more comfortable with evaluating my students' work. It was almost as though they were part of a scientific experiment and my task was to collect accurate data about their science knowledge. While grading their work I was getting more and more confident in the validity and accuracy of the scores they were receiving. As long as I was able to assign a point value to the different parts of the assignment, I felt the grades they received were truly an accurate representation of what they knew.

Adding to my assurance about their grades was my confidence in my knowledge about the science I was teaching. I get inspired when I learn something new about the physical world, and my college days had been one of the best times of my life for learning. I wanted to see my students have the same excitement for learning about the world that I had. I felt my knowledge about science could really benefit my students. There were so many interesting aspects of our world I understood, and I truly wanted to help those sixth-graders understand and get excited

about nature. My teaching was hopefully the pathway the students could take to get juiced about learning.

Because I was teaching science there were many opportunities to have students participate in labs and classroom activities, something some might label as progressive education (see Dewey, 1938), which is how I felt as I taught my first few years. If my students were working in groups or were doing activities in class, I viewed my teaching as cutting edge. My perception about science teaching was that these experiments and activities were great ways to supplement the notes given in class (in contrast to the quite different notion that notes and class discussions are a great way to supplement student experiences). The labs or activities should reinforce what the teacher explains to the class (in lecture format usually). It wouldn't be until later (chapter 16) that I would begin to question my mindset about the value of my spoken words over student experiences. As Dewey (1938) might argue, even though I was giving my students lab experiences, those experiences may have been of the wrong kind; they may have been "mis-educative" (p. 25). As it stood, the words I spoke were the most important in the classroom; my job was to fill my students' heads with what I had already learned about the world. I was doing just as Friere's (1970) banking concept of education described.

For example, when teaching about the metric system the teacher should first describe how the system works (such as how the system is based on tens, unlike what we have here in the United States with inches, feet, and yards). In addition the teacher should define or explain the prefixes so the students would understand what each is and how to convert among the different metric prefixes (such as milli-, centi-,

kilo-, etc., and moving the decimal point to the right or the left). Once the teacher explained the system and the prefixes, then the students should be given a chance to measure different objects and use the metric prefixes they had been taught. The labs and activities should also give the students plenty of practice at manipulating and converting among the different prefixes. After the explanation, labs, and activities, then the students would be tested on their understanding of what was explained to them.

This format for teaching the metric system was one of the first science units I did with my sixth-graders. We spent a total of about three weeks discussing the metric system and doing worksheets, labs, and activities. I honestly thought they would be able to understand how the system worked. During class, it appeared as though many of them had an understanding of how to use metrics, and as such, I felt comfortable that they would do well on the test. I intentionally wanted to make my tests difficult, similar to what I experienced in college. Many of my science professors made their tests so difficult that very few students made above a ninety percent. I also felt I would experience a sense of pride and maybe even power by giving such a challenging test. I remembered from my high school days not having to study for many tests, and I wanted to give my students a reason to work.

Despite explaining the system several different ways and giving them several activities about the metric system, many of my students did poorly on the test. I was shocked they could not show their understanding of the metric system. I could not help but think that the preceding three weeks were a waste. I wondered if they understood what we had been doing in class the previous days. I questioned if the

test had been too difficult for sixth grade science. I wanted to have my students understand the simplicity of the system, but many found it entirely confusing. I tried to find different explanations for their poor scores. Reasons such as the students not studying enough, not doing the homework, and not trying were tops on my list.

In order to send a message to my students about these excuses (excuses which I wanted to eradicate as soon as possible), I had the students correct their tests by doing lengthy and time-consuming work on the problems they missed; I wanted to go to "war" with the laziness I thought was rampant in my students. Just as William James (1958) describes:

> The fighting impulse must often be appealed to. Make the pupil feel ashamed of being scared of fractions, of being "downed" by the law of falling bodies; rouse his pugnacity and pride, and he will rush at the difficult places with a sort of inner wrath at himself that is one of this best moral faculties. A victory scored under such conditions becomes a turning-point and crisis of his character. It represents the high-water mark of his powers, and serves thereafter as an ideal pattern for his self-imitation. (pp. 51-52)

By demanding so much from those students who did not do well on the test, I thought this would serve two purposes. First, it would hopefully get them to understand the metric system more, and second, it would motivate them to study and apply themselves more for the next test; to get serious about learning the information in my class. I genuinely wanted them to learn the system; this seemed to be a good way to encourage them to try harder.

Even though I hoped the students would learn from their mistakes, I'm not sure that having the students correct their tests did much to help them. I was certain if the students had studied more, they would have done better on the test. There were several students who did well, and those were the ones who seemed to try hard and study. I wondered if there were other methods I could use to could get the students to try harder to learn the science I thought was so important.

I decided for the next big unit I would go to the extremes. I had recently been inspired in a meeting at my school with an accomplished educator, Mr. Elliot, who had a reputation for being an exceptional teacher. In fact, he had been a state teacher of the year, and came close to becoming a national teacher of the year. In the meeting, which focused on instructional strategies, Mr. Elliot talked about his classroom and how he tried to get students to work together to solve mathematical problems. From what I could gather, he didn't answer many questions the students asked, but instead, returned their questions with questions of his own to guide their thoughts about problems. It appeared as though he valued his students' responses and angles to the problems he presented in class, and took care to try to understand their interests and tailor his teaching to meet the students' needs.

As part of the meeting, he gave us new teachers in the meeting several examples of the kinds of problems he posed to his students, and he also discussed some of the answers that students had arrived at on their own. He came across as being not only passionate but also effective in helping the students learn; I was challenged to try some of his ideas in my own classroom.

Inspired by what I heard at the meeting I decided to allow the students to come up with their own science questions to which they wanted to know the answer. I assigned them the task of coming up with several questions they thought were interesting and worth looking into. I then assigned them groups and had them share their questions with each other; they were then told to pick one question to investigate, write a report, and give a presentation to the class over what they discovered. I hoped this would motivate them to work harder to learn and give them a sense of shared responsibility within their groups (Marzano, et al., 2001).

The students came up with some very interesting questions. For example, some wanted to know why the moon appeared larger when it was closer to the horizon. Others were curious about why water and oil didn't mix, what would happen if a person entered a black hole, and how long it would take for the earth to reform into one large landmass, Pangaea. I was impressed with the questions the students were asking; my hope was that they would get energized about the joy of understanding how nature worked.

The students worked in their groups for several days researching the problem, creating a presentation, and writing a report to give to me. As I observed them working, I discovered there were about two students per group of five that worked hard and took to the task of understanding the problem (the same collection of students who did well on their metric system test). The others in the group went along with the two "smart" ones and didn't do much work; not all of my students were motivated to the extent to which I wanted. They all appeared to be excited about working in groups and having class time to do their problems, but some of them

seemed more interested in the social aspect of the project. My goal of getting all of my students excited about understanding nature was still not being accomplished. Although many of my students gave the impression that they enjoyed doing the project, I began to question my ability to motivate my pupils about the joys of science.

When I expressed my concerns to my team, they were very reassuring about my abilities as a teacher. Although I had never taught middle school before, the whole idea of middle school teaming was beginning to come in extremely handy. Teaming was demonstrating to me that talking with other teachers was a valuable tool for not only students but also teachers. As the National Middle School Association (2004) states, "Students and teachers in schools that have implemented teaming and its associated practices with some degree of integrity consistently report more positive and productive learning environments" (¶ 2). I was beginning to see firsthand how effective teachers could be if they could spend time talking about educational issues and classroom concerns.

My team mentioned they were seeing some students work harder in my class than in any of their classes. The teachers also encouraged me to continue with my high expectations; they admired my willingness to challenge even the brightest kids. I couldn't tell if they were feeding me a line or if they really observed the things they were saying. But even in the interviews I had with them recently (five years after teaching with them), they mentioned the same thing—that I had high expectations of my students (personal communication, 2004). One teacher in particular mentioned the activity described above and said she was very impressed that I tried such a project

and that the students actually did so well on the assignment. She was very complimentary about me expecting, and getting, so much out of my students.

About the time the students were giving their presentations and turning in their reports, it was time for the first nine weeks' grades to be turned in. And, just as with my other assignments I had a numerical value attached to the different parts of the project to help me calculate their nine weeks' and semester grades. During my student teaching, I had helped my supervising teacher calculate grades, but I was never sure what he ended up giving the students in the end; I was only a small part of the grading practice. Now, I was solely responsible for giving my students grades. Because I had been so thorough in grading student assignments during that first nine weeks, I was very confident the percentages were really a reflection of what the students knew.

Just like a seasoned statistician, I assigned an "A" only to students who made an 89.5 percent or better; an 89.4 percent was a "B." As a science teacher, the process of doling out grades became a scientific process; the grades the students earned were scientifically accurate (for a description of the "scientific curriculum" see Doll, 1993). The curriculum for my students contained a certain body of scientific knowledge my students should know; if there were aspects of the curriculum my students did not know, it would show up as a lowering of their grades.

I saw the grading system in terms of measurable goals and outcomes, and it had very clear line differentiating what constituted each letter grade. If a student did not do well on tests or other assignments, the grade earned would represent a deficit in student learning. As Doll explains in his evaluation of modernism in education

today, "…evaluation in terms of grades is the assessment of how much of this canon and its method the student has acquired. Phrased differently, grades are a way of measuring the 'deficit' between the canon presented and the canon acquired. In this form, evaluation becomes a way of measuring deficit…" (p. 172). I was confident the grades my students were earning were giving a clear picture of what they actually knew about science and the curriculum in my class.

As the year progressed, I continued these same grading practices, even through the pleading of some students who were on the verge of getting a higher grade. I simply told them there were plenty of opportunities throughout the weeks to get better grades; I was bound by a grading system that all teachers used. Plus, it wouldn't be fair to give students grades they didn't deserve; I stuck to my grading guns. It wouldn't be until later (chapter 11), that I questioned my confidence in grade percentages and even the idea of quantifying learning (including the Intelligence Quotient; Gould, 1996).

About the time I was calculating grades, basketball season started and I began my first season of coaching. Being a coach is a very time consuming activity, and I began to understand why my college professor wanted to know if I was going to be one of "those coaches." Balancing teaching and coaching proved to be very difficult. The games were twice a week in the evenings, and practice was everyday after school. It was extremely difficult to put the effort into teaching after spending late evenings at games. I didn't want to bring a lot of my work home because I didn't want to sacrifice any part of my marriage to my job. I struggled through the tiredness

and long days and managed to survive the season. Despite my fatigue, however, I was able to learn about teaching through my experiences roaming the sidelines.

As a coach, I wanted to garner the same respect I did in the classroom; I wanted my players to respond to what I expected. As a teacher I thought that being firm and rarely smiling were avenues to obtain the respect I needed. However, in coaching I was able to actually participate with my players during practice. I did the drills and ran the floor with them during scrimmages; I even joked with and taunted them. Surprisingly, my players didn't appear to loose any of the respect they had for me. If anything, they seemed to have more respect because I was in the trenches with them and was able to have a lighter side. My coaching personality slowly started to bleed into my classroom personality. Gradually, my demeanor in the classroom became more and more fun-loving while still maintaining the high expectations. I even started playing football with my students during our team activity time on Friday afternoons.

What began as a school year filled with firm looks of seriousness, slowly and progressively turned into a school year with smiles and jokes. The other teachers and the coaching allowed me to see a lighter side of education and to include that into my classroom personality. I was beginning to understand how my positive emotions (i.e., joy, happiness, laughter) could be used in the classroom to help my students connect with me and to make the class more interesting and fun (Jensen, 1998). Although my teaching methods did not change much because of this evolution, the atmosphere in and around my class was much more light-hearted than what it had been at the beginning of school.

The school year continued to press on as my classroom personality evolved. I was still quite confident in my knowledge about science, and I became more secure in my teaching methods. Notes would still supplement activities/labs and the tests would still be challenging to a majority of the students. I was somewhat resolved that some of my students just weren't trying hard enough at school, and that they would not make the grade. In fact, each week I would have about five to ten students (out of about 125 students) on the ineligible list with flunking grades. I didn't feel they were trying as hard as they could, and they deserved the grade they had. I believed I was doing all I could to help them pass. The information was given several ways to them in class; they could ask questions in class if they needed help. But despite my efforts, many of those students on the failing list continued there most of the year.

CHAPTER 7

MY FIRST CLASS, AGAIN

As the school year began winding down, the staff was informed that the seventh and eight grade students from our site would all be relocated to attend a different site next year, and that teachers would be transferred with them; the current school would house fifth- and sixth-graders only. This was good news to many since the seventh and eighth grade site was new construction, built specifically for middle school students. The move would also separate the sixth-graders completely from any contact with seventh- and eight-graders, something many teachers saw as a benefit. The teachers did not want the older students bullying or negatively influencing the much less mature sixth-graders. However, because the school I was currently teaching in would only have fifth- and sixth-graders, it would be considered an elementary school; I was certified to teach secondary science, not elementary. I quickly learned I could not teach sixth grade science the following year.

I promptly set out looking for high school science positions within the district, but none were available. I learned there was, however, a position available for seventh grade science at the new school; I made my interest known and was quickly informed of my interview time.

I prepared for this interview the same way I did my first one with the district. However, I did have many more teaching experiences from which to draw, and I even brought some samples of student work to the interview to show what my students had been doing during the year. The interview seemed to go great and within a few

weeks I was informed that I got the position; I would be teaching seventh grade science in a new school with new science supplies.

During the same time the teachers were being informed of the move into the new school, the district made known that they were going to offer the chance for teachers to get their master's degree within a fifteen-month time period. The degree would be in the historical, societal, and philosophical foundations of education, a subject with which I was relatively unfamiliar. The program being offered, called a "cohort," would be through a state school; the university would send professors to the district's campus and would teach the classes in the administration building. The participants would all have the same classes and would have fifteen-months to build relationships with other educators, mostly from within the district. It would be an accelerated degree that would require a significant time commitment as well as a considerable amount of work in addition to the teaching load the participants would maintain.

Having just graduated college a year earlier, I felt I might be a little young to work on my master's. I also had reservations because I would be teaching a new subject and continuing my coaching responsibilities; I was unsure about the time commitment and the balancing act I would have to maintain with a job, family, and master's program. In addition to the time commitment, there was a financial commitment as well. Like many graduates, my wife and I had accumulated school loans from our undergraduate years, and we both wondered if it was wise to spend more money on more schooling. Even the subject matter of the master's degree made me somewhat reluctant. I wasn't sure if I even wanted to stay in the educational field.

Having only taught one year, I didn't know if I would continue to enjoy teaching or even enjoy the educational system. By getting a master's degree in education, I was almost ensuring that I would work in education for several years. But I truly enjoyed learning and hearing others' ideas; it was a difficult opportunity to pass up. Despite what some might consider better judgment, I signed up to start the master's cohort.

The first master's class was scheduled for June of 2000. Even though I had taken the required education courses for my undergraduate degree and did well, I was unsure about how I would fare in a master's program dedicated to educational issues. On one hand, I felt the information and required work would not be more rigorous than I experienced taking science classes during my four years in college. On the other hand, as an undergraduate I didn't particularly enjoy the education classes compared to the science classes. I had my doubts about how involved and interested I would be in the fifteen-month program.

On the first day of class that June, I was expecting to start off with the typical teacher introduction and then get into the nitty-gritty of educational issues. I imagined the professor would be stoic, firm, and business-like. I envisioned our class time being spent taking notes and getting assignments for the subsequent classes. I didn't get what I was expecting.

When I arrived (a few minutes early, of course), I was surprised to see the professor in what looked like a tamed-down Hawaiian shirt and khakis. He was smiling and telling jokes and stories about anything and everything. He was calm, welcoming, and approachable, something I did not expect to see in a graduate

professor. When class did "officially" begin, it started the way I had imagined—with a teacher introduction. What I did not expect, however, was that after his introduction, he went around the room and allowed each of us the chance to introduce ourselves; the professor appeared truly interested in who we were. After about an hour of introductions, which seemed to be a bit of wasted time to me, we then began talking about some educational issues. I didn't end up taking many notes; it was a very informal session, but very informative time of discussing some of the educational issues we faced as teachers. One specific area involved grading practices among teachers.

The issue revolved around what grades actually mean in education and how we as teachers determine grades. One member of the class began to describe a grading method that involved determining a student's average by using the teacher's professional judgement as a major component of the grade. To me, this seemed completely unfair and subjective. Coming from a modernist perspective on the "scientific curriculum" (Doll, 1993, pp. 47-52), I wondered how a teacher could use such a skewed and inexact method for determining a student's *legitimate* grade. I had spent a good portion of my first year of teaching assigning point values to different parts of assignments; there didn't seem to be any scientific and accurate way to give grades otherwise. Just as in science, I wanted my grades to be valid and free of personal opinion; the method being described was full of personal opinion and teacher bias. So I asked the other teacher how he would defend this grading system to parents or even to the students.

After a brief moment of thought, he responded by talking about the teacher's "professional" judgment and the role of the teacher in determining what a student's grade should be. He discussed his time taking education classes to become a teacher and how those classes trained him to evaluate students without the continual use of quantitative scores. To him those classes qualified him to do what professionals did in his mind—*to make decisions*. To me, it seemed as though this teacher did not spend as much time as I had on trying to get an accurate and valid score on student work. I could not see how I would ever determine student averages by such an inaccurate and unscientific manner.

We even discussed standardized tests in our conversation about grades. In my mind, standardized tests were the capstone of accuracy and validity concerning a student's knowledge. After all, in those tests, there can only be one correct answer and such tests are a large part of the accountability measures in the No Child Left Behind Act (US Department of Education, 2005). Hurwitz and Hurwitz (2003) even describe school systems that have improved student learning by using standardized testing. "Test scores provide an aura of businesslike accountability for superintendents, principals, and teachers and a stimulus for students" (p. 151). Unlike my mystery box project, standardized tests created an ideal environment to assess student understanding without the subjective viewpoint of an opinionated grader. The multiple choice format and the statistical formulas used to calculate percentiles and averages made sense not only in scientific terms but also in plain common sense terms. I felt confident these types of rigorous tests would be ideal to rank and sort

students across the United States; it would be a perfect measurement tool to compare students nationwide (or as close to perfect as one could get).

Despite my views on the effectiveness of standardized tests, there were a few of my fellow teachers in the class who did not view these tests as accurate measures of student knowledge; these teachers were not as confident about the tests and the accountability measures in NCLB as I was (Marshak, 2003). As the discussion continued, I learned that these educators taught subjects such as art, orchestra, and vocal music.

I understood their point of view in regards to their subjects, but I still could not see how their arguments applied to subjects such as science and math where there were concrete answers to questions. It is difficult to describe a "good" painting or a "good" song, one that everyone can agree upon. People will have different likes and dislikes in art and music which makes it very difficult to determine "better" songs or works of art. However, it is much easier to determine "good" science from "bad" by looking at things like variables, controls, experimental set-up, and the data. Art and music also include emotions and feelings when talking about the particular piece of work; science attempts to eliminate these so the final result will not include the beliefs or values of the scientist (Starr & Taggart, 2004).

Throughout that first summer of classes I don't think I persuaded anybody to my point of view, but I wasn't swayed either. Because I felt I was the most knowledgeable about science of the teachers that were in program (I was the only science teacher), I was convinced I was right and hoped I could eventually get my point across. Fortunately, there was a good mix of people in the class, some who

were closer to my scientific views on testing and some who were closer to the "artistic" view of testing. It made for good class discussions, and their opinions made me think about my own.

This class also introduced me to something which I still thoroughly enjoy to this day—educational literature (not just educational textbooks). In undergraduate school, the books I read in my education classes were written like typical textbooks (Slavin, 1997). They didn't tell many stories, were dry, and inevitably had bold words to let the reader know what concepts were worth knowing. However, the professor in our master's class assigned us a book that was nothing like a textbook—Jonathan Kozol's *Ordinary resurrections* (2000). Not having read any book like this before, I was surprised at how much I enjoyed the way Kozol wrote about the young kids from the South Bronx. The poetic stories he told and the questions he raised challenged me to look beyond my suburban, affluent district when thinking about education. The boys and girls from his book made me look at not only inner-city kids differently, but also at the students in my district differently. I began to see these students not as future businessmen, lawyers, factory workers, or doctors, but as kids who have struggles and dreams like most kids *should*. "They love their mothers. They pray for their grandmothers. They talk to animals. They make up stories. If you have a dog they want to know its name" (p. 5). Kozol introduced me to the "kid" in the student.

The cohorts, as we students were called, took a total of nine hours that first summer. As I was doing work for the professors, I also began the task of starting a new school year, with new students, a new classroom, and a new subject. Just like

my first year of teaching, I felt fortunate to be on a "team" for my second year. However, the process of learning about the personalities and nuances of the team members and the seventh grade science department had to be repeated.

When I met the teachers with whom I would be teaching that year, I felt I was starting over; I didn't know any of the seventh grade teachers. Adding to my anxiety was what I learned about the job I now had. When I had interviewed for the position, I assumed the teacher who previously held the job was leaving or changing jobs. However, the teacher was a first year teacher just like I was and was not guaranteed the seventh grade science position just as I wasn't guaranteed the sixth grade science position. We were both interviewed for the same position; the one she had held the previous year. For reasons unknown to me, the administration chose to split up the team of four teachers by replacing the previous science teacher with me. Naturally, I felt not only like I was starting my first year over again, but also like I was going to be a target for the three other teachers who had lost their friend and colleague. I was not just going to be challenged with a new academic subject, but I felt like I was going to be treated like a second-hand toy in the hands of a spoiled toddler.

When our new team met over the summer to discuss the upcoming school year, I was naturally a bit guarded and reserved. I wasn't sure how I would be perceived so I did my best to be professional and business-like. It was the safest way for me to interact with the new teachers. The whole experience was very similar to how I started with the teachers from sixth grade. I didn't offer too many suggestions, and I was agreeable to most ideas they offered so as to not be viewed as someone who thought he was high and mighty. Although I didn't want to disagree with the

suggestions of the team, honestly there weren't many ideas I thought were awful or unreasonable. The three teachers wanted the students to enjoy school and have a great seventh grade experience. We discussed things like how students would organize their academic folders, what dates we would take field trips, how we would complete a baseball unit (where the students actually got to play baseball and learn about different aspects of the game in each of the four core subjects), and to what upscale restaurant we would chose to take our students in order to culminate our etiquette unit. I felt as though this atmosphere was much closer to what Hord (1997), Huffman and Hipp (2003), and Cate, Vaughn, and O'Hair (2006) describe as a "professional learning communities." In contrast with what the sixth grade team did, this team seemed completely committed to using the team concept and collaboration time to get the students involved and interested in school (National Middle School Association, 1982). They also did their best to make me feel welcome and a wanted part of the team. By the end of our meeting, I was more secure in my role as a team member and colleague.

When the school year began to close in on us, I felt I should be confident in my authority and position as a teacher. I didn't. When I was teaching sixth grade, I was confident in interacting with any student in sixth grade or younger, but, I felt a bit insecure around students who were older. Even though I student taught in high school, I wasn't sure about how best to deal with seventh and eighth grade students. Partly because of these feelings of insecurity, I decided the best way to begin the school year with the students was the same way I began school with the sixth-graders—firm and unyielding.

Even though I read Kozol's book (2000) and was challenged to look at students as kids, I didn't feel I could adequately get control and respect from my students by seeing them as kids. Also, Kozol's book was mainly about children under ten years of age; I was dealing with students on the verge of puberty, with those who were knocking on the door of adolescence and were growing out of the happy-go-lucky age of innocence that Kozol described. So as I began to prepare for my seventh grade students, I used my experiences teaching sixth-graders as my guide to how I would start off the new school year.

The same anxiety and restlessness I felt during the weeks leading up to my first day teaching sixth-graders was repeated as I pondered how I would begin class with the seventh-graders. Like other teachers, my mind could not escape from the thoughts about how best to begin the new school year (Inchausti, 1993; Wigginton, 1985). I determined that the procedures used when teaching sixth grade would be just as efficient and effective for seventh grade. Since the team I was on required every student to keep a folder for each of their core classes, I was able to add several more procedures to my classroom repertoire. I also determined that I would try to minimize my smiles to only rare occasions during those first few weeks (I had given up on trying to hold out until Christmas; it just wasn't possible.). But unlike what happened my first year in the classroom, this second year added a dimension to the job that truly began to improve my teaching.

As mentioned earlier, this second year of teaching started off with more of a team focus on the students. There were, however, two of the team members with whom I was able to really connect, and we talked frequently in the days leading up to

first day of school, much more than what was done during my first year. Ms. Seilig and Mrs. Robb were two teachers who epitomized what it meant to be middle school teachers. They had a firm grasp on what middle school students were going through emotionally, physically, and socially (Carnegie Council on Adolescent Development, 2000); they were eventually able to help me understand some of the things that go through the mind of an early adolescent. Partly because of the difficult experiences they had undergone during their middle school years, they were dedicated to ensuring that as many of their students as possible were able to enjoy seventh grade. Ms. Seilig and Mrs. Robb were also best friends, which added to their effectiveness as teachers and helped to avoid teacher burnout (Wigginton, 1985). They were constantly talking about what they could do with the students and how they could get kids more involved and interested in school, a practice many researchers are finding effective (Caine & Caine, 1997; Little, 1987; Little, 1990; Schmoker, 1999).

Despite their openness and willingness to help, I was still hesitant to ask for much assistance. I didn't want to appear insecure or uncertain about my understanding of students. Even though Ms. Seilig and Mrs. Robb were extraordinary teachers and great people, I didn't have the desire to spend much time talking about menial things. If I had a question, I would pop my head into their room, ask my question, wait for a reply, and then be on my way. During team meetings, I wouldn't contribute much to non-school conversations such as the type of Italian restaurants I preferred or the kind of Bunko prizes I desired. In fact, when these conversations would come up, I would do my best to redirect the meeting; I wanted to

get back to the task at hand, and the idle chit-chat was unproductive to our effectiveness with students.

Although the team teachers helped me with the procedural and non-science aspects of teaching, they couldn't help much when I wondered about how best to teach about mitochondria and chloroplasts (partly, I suppose, because I never thought to ask). Luckily, the other seventh grade science teachers were more than willing to help. In fact, they not only wanted to help the "rookie," they also wanted to help each other; they appeared to be committed to helping each other find the most effective ways to get students to understand science. Although the department didn't meet often, it was refreshing to sit with five other science teachers and discuss what we were doing in our classrooms. Beginning that second year, it was though I had the best of all worlds—science colleagues to help me teach science, and a team to help me with everything else.

CHAPTER 8

GOOD NEIGHBORS

The first few weeks in the classroom teaching seventh grade was very similar to what I experienced the previous year teaching sixth grade. Although I didn't catch any of my students stuffing their bodies (or anyone else's) into the lockers, there were minor infractions, such as chewing gum and running in the hall, that allowed me to flex my disciplinary muscle. By addressing the small issues in a strict and matter-of-fact way, my position of authority wouldn't be tested as much compared to if I were to let the small things slide; demanding students spit out their gum was one of the small, but significant ways for me to obtain the respect of the students. The uneasiness about teaching older students faded as I gained confidence in my ability to control and manage their behavior. I was also reassured in my position in the classroom because of what I knew about science (just as in my experiences teaching sixth grade). Whereas the focus in sixth grade science was general science (i.e., weather, chemistry, nutrition), the focus during the seventh grade was life science, something I thoroughly enjoyed, even as a young child. Although I liked the sixth grade content, I truly felt as though the subject matter for seventh grade would allow me to be more creative and more informative.

Despite what I felt, I was a relatively new teacher without many resources for teaching any subject, including life science. Even though I had taken upper level science courses in college, I still found it frustratingly difficult to create activities that would complement the notes given to my students in class. The teacher's edition was some help and was used on occasion, but the textbook suggestions never seemed to

offer what I thought was good enough (Padilla, Miaoulis, & Cyr, 2000). Fortunately, my classroom was next door to one of those seventh grade science teachers who was eager to lend a hand, Mrs. Clark. She would turn out to be a tremendous help and to this day, because of Mrs. Clark and others who were willing to talk about educational issues, I find that good neighbors make for good teaching.

One of the first activities we decided to do in class involved the students learning about measurements, observations, inferences, and the methods of science. We accomplished this by having the students do an experiment on chewing gum (Center for Inquiry Based Learning, 2000), the forbidden fruit in our school. Because our school was new, there was an aggressive effort to keep the building and its contents looking new and clean, and gum was not allowed—anywhere. Even teachers were encouraged to kick the habit while in the building. Most every school I had attended or been in had the "no gum" rule, or something similar, but relatively few seem to follow it or care that the rule existed. Not in this school. There were actually posters around every corner and in virtually every room touting the "no gum" rule. The administrators took it very seriously, and as such, teachers were supposed to take it very seriously. Because of the strict rule, and Mrs. Clark's experiences in the past with this activity, we thought it best to ask permission before we did our gum activity; we thought it would be a considerate act, especially during the first few weeks of school. The principal quickly gave us the okay to proceed, provided the gum not leave our rooms.

After discussing measurements and the scientific method we began our activity as a way to supplement the notes the students had taken. But, before starting

the activity in class, I laid down the law to my students about what was expected with the gum in school. They were only to have the gum in my room on this day, and the wrappers, as well as the gum, were to be placed into the trash before leaving the room. If the principal was to catch anyone in the hallways with gum, it wouldn't be a student from my room.

For the activity, the students were to take both quantitative and qualitative measurements of the gum before and after chewing the gum; they would then try to determine if and why the measurements had changed. They would also compare different brands of gum within their groups to see if they could find any patterns within the data. Prior to chewing, each student took the mass, length, width, height, and made other observations about the stick of gum in front of them. Once the students had finished recording their observations, I gave the instructions on how to chew the gum. I explained that the group members would need to chew at about the same rate and intensity so their brand comparisons would be consistent and valid. If one person chewed their gum with more enthusiasm and aggression than others, he or she might suck more of the "stuff" out of the gum and thus, distort the data within the classroom. They would also need to chew the gum for equal lengths of time for the same reason—so one student didn't chew longer and suck more of the "stuff" out of the gum. As the overseer of the experiment, I determined I would be the official timekeeper (I decided to keep time to prevent some groups from chewing their gum the entire hour and not working on the activity).

Once I gave the signal to start chewing, it was though the students had entered the mystical land of Willy Wonka's Chocolate Factory. They took pleasure in every

last chew. As the students were savoring their rebellious mastications, I meandered around the room making observations of my own. I was genuinely surprised that they enjoyed chewing the gum as much as they were letting on. The combination of doing something forbidden and having a teacher's permission to do it must have given them an added sense of enjoyment. I wondered why they got so much pleasure from doing something against the rules. Was it human nature to want to break rules? Did the MTV culture encourage them to enjoy rebellion?

I also began to wonder about the no gum policy. It made sense to want to keep the school and its equipment clean, but to be so strict and authoritarian about it seemed almost too extreme. The administration had little tolerance for gum or candy, unless it was for academic purposes (and using it for rewards was not considered academic). I had never been the insubordinate type, but my students didn't leave one piece of trash on their desks after the activity; why couldn't they chew gum in my class? It seemed reasonable if my students were going to be respectful about the rules that they should be able to chew gum in my class. These thoughts stayed in my head that year, and I didn't allow my students to chew gum. However, from that activity I began to question some of the policies we teachers dealt with on a frequent basis.

For example, I began to wonder about the policies in place for teachers during school "work days." In the district, there were a couple of days throughout the school year that teachers were given a chance to work in their rooms without students present. The time was a wonderful opportunity for teachers to get caught up, take a breather, and even collaborate with their colleagues on the curriculum. However, on these days teachers were expected to stay at school for a certain amount of time,

which to me and most teachers with whom I was working, seemed reasonable. But apparently there were some teachers at our site who were known to detest these work days and, if given the opportunity, would not show up to school at all. To combat the defiance and ensure that all teachers were present, the administration required each teacher to sign-in and sign-out on work days. By so doing, all teachers were held responsible for being at school for certain hours during the scheduled work days.

To me, it was juvenile to have all teachers sign-in and sign-out on days we were assigned to work just so a few teachers would feel some sense of accountability. Although I did observe several teachers who were habitually late and appeared to use their teaching job solely as a means to make money, I didn't think it was appropriate to require that we check-in with the principals. It was though we were factory workers punching a time clock to earn our wages. We were professionals, and I could not see the value in having teachers check-in so the few teachers who were taking advantage of the system could be given motivation to show up. The principals, I felt, were trying to use politically correct methods to make all the teachers show up, but I viewed them as being unwilling to address the issues with the teachers in question.

I started to question this policy, among others, and it began by observing my own students chewing gum in class. When the gum activity was completed, Mrs. Clark and I discussed what we thought about the activity. We both agreed that the students really enjoyed chewing the gum and even enjoyed making measurements. The students appeared to understand the concepts we were covering, and we talked about what we would do next in our classrooms. Having taught seventh grade for two

previous years, Mrs. Clark had some great ideas and experiences from which I was able to draw. I was so encouraged about her ideas that I asked if she would want to collaborate more consistently to create lesson plans for our students. She agreed, and we decided to meet at least once a week to talk about what and how to teach our students.

Through these weekly meetings, we were both able to sharpen our skills as educators. Even though I had been assigned a mentor my first year teaching sixth grade, we were never on the same page with our curriculum in the classroom. She would give me ideas and encouragement, which she excelled at. But she was reluctant to consistently do the same thing in her class as I did in mine (or possibly, I was the reluctant one and wasn't willing to do the same thing in my class that she was doing in hers). With Mrs. Clark, I found someone who was willing and able to do similar things in the classroom each week; our ideas about education also seemed to be very similar. When one of us would have an idea, it would get refined and focused during that weekly meeting. It also took some of the burden off of us as teachers. I found myself worrying less about my classroom during my time at home; the fictional classroom that was a staple of my imagination during my first year teaching was emerging less frequently. I was beginning to enjoy my time at home with my wife without the stresses of how to teach class the following day; my homework load was waning. Just having someone to talk to about the frustrations of the curriculum was also beneficial. Because our courses were very similar, if something bombed in my room, I could go to her and see how she handled it.

I was also warming up to Ms. Seilig and Mrs. Robb. While Mrs. Clark and I met weekly, Ms. Seilig, Mrs. Robb and I met daily. As the year progressed, our relationship began to grow and mature, and I became more willing to express my opinions. I was also more courageous, and maybe even a bit cavalier, about trying to get our team meetings on track and focused. Their boring conversations about who didn't get a rose on the television show *The Bachelor* seemed to be a waste of good working time, and I was now more apt to let my boredom show. Luckily, they both had a good sense of humor and would get the meeting back on track while making light of my "let's get to it" mentality.

The daily team meetings, although boring at times, were extremely valuable for not only me, but also for our students. At these meetings, we would have the opportunity to discuss our students' performance, and since we all had the same group of students, we could discuss what strategies seemed to work and which ones didn't. We could also talk about team disciplinary problems and how best to manage the problems we encountered in the classroom. The team time was also used to discuss our non-academic curriculum such as character education and our team's etiquette unit, something no other team did at the time.

The etiquette unit was one of the first experiences I had with in-depth teaching about a non-science subject in my classroom. About once a week during homebase, or as some call it, homeroom, we teachers would discuss different aspects of mannerisms including phone, table, and conversational etiquette to the group of about twenty to thirty students. We would give our homebase students notes and even role play different scenarios. When we finished the unit (which took about twenty weeks

to complete), the students would take a test over the information; those who passed the test would be given the opportunity to go to an upscale restaurant to put those skills to work. Fortunately, through review and retesting, we were able to ensure that virtually every student passed the test and was able to attend the etiquette luncheon.

Throughout the entire unit, I was encouraged to see our students using their manners when walking the halls and interacting with adults and other students. Although there were many times students were not "polite," each of the team teachers was able to use the etiquette unit as a reference to what we expected of the students. If we teachers were talking in the hall during passing time and a student needed one of us, each one of our students knew (because of the notes we teachers had all given during homebase) they shouldn't interrupt our conversation unless it was an emergency. They were instructed to wait patiently in view of one of us and wait for a pause in our conversation; then they could begin to ask their question. Although some students got to hear the lecture several times because they frequently interrupted, by the end of the school year, most, if not all students understood what we expected and were excellent examples of how to act in public (at least when the teachers were within eye and earshot). Just as with Mrs. Clark, I was now seeing how the time the team spent in daily collaboration could be a huge benefit to our students and to us as teachers.

As the year continued, the teachers with whom I worked became more comfortable with me and I with them. The daily team meetings were becoming more productive because we understood each other's nuances (as long as they were on task, of course). The weekly meetings with Mrs. Clark were also going well, but it seemed

we could do even better with the input of the other science teachers. For our plant unit, we decided to enlist the help of the other seventh grade science teachers, so we put out the word that we wanted to get their opinions on ways to teach about plants. Apparently, there was the same desire among the other four science teachers to collaborate and discuss the curriculum, so setting up a time and place came quite easy.

At the meeting, all six of us were interested in doing what we could to help our students learn and understand certain concepts about plants. There was great leadership within the group, but being new to the department I was hesitant to offer any of my own opinions and suggestions. Even though I had been in this same situation several times within the past year and a half, my confidence in my teaching abilities was still not at a place where I thought I had much to offer. I did, however, have something to offer by way of my knowledge of science. Of the six science teachers, I felt I knew as much or more science than the others; I thought if I were to contribute anything, it would be about science.

As we began to discuss plants, one of the teachers talked about an experiment she planned on doing with her students to help them understand the scientific method and experimenting as well as the growth and health of plants; it was called a Dirt Baby. A Dirt Baby is basically a ball of soil and grass seed wrapped inside the toe end of pantyhose. The pantyhose-wrapped ball is then placed into a small cup and watered; within a week, the "baby" begins to visibly grow (provided it is watered and maintained) and will continue to grow for about a month thereafter, reaching heights of up to fifteen centimeters or about six inches. Although the grass wasn't grown in

the best of environments with the best materials—something I had wanted for my students even since I was student teaching in the basement of that small, rural school—it turned out to be a very simple and creative way to grow plants within the confines of school budgets and school facilities.

The teacher who talked about the experiment explained that she planned on having her students start the Dirt Baby before they even discussed plants in class. She would have them design an experiment in groups (having one plant in the dark and one in the light, for example, or adding salt water, sugar water, and regular water to the plants), and carry it out without much assistance from her. Even though she was a seasoned and well-respected teacher who had been named district teacher of the year, to me, her sequence seemed backwards. I imagined the students would make too many mistakes and waste time and resources in the process. I didn't feel students could design and carry out an adequate experiment without first learning about how the plants worked and what they needed to survive. I thought the students needed a good lecture and set of notes to supplement the lab experiment.

I also thought the students needed more guidance when setting up an experiment. Without help from me, the teacher, the students would be floundering with their Dirt Babies. After all, as a teacher, I imagined one of my responsibilities was to limit the mistakes my students made; creating Dirt Babies before talking about plants seemed like a bad idea. However, at the same time we seventh grade teachers were discussing how best to teach our students about plants, I was taking a class in the master's cohort about curriculum development that would begin to challenge my

thoughts about student learning, including how to let students experiment with Dirt Babies.

CHAPTER 9

EXPERIENCING MISTAKES

My thoughts on education and learning up to this point had been largely shaped by what I observed other teachers doing. Whether it was good or bad, I took what I saw being done (to students, to me, or to classmates) and made mental notes about what I liked and disliked about education and what worked for me both as a student and as a teacher. Even though I had taken several education classes in undergraduate school, I hadn't yet applied those lessons to my classroom; I mainly used my experiences as a student in the classroom to help me understand my role as teacher. As Caine and Caine (1997) explain:

> Even people who might have different views of what they want education to accomplish often share deep beliefs about "school" and teaching, which are not grounded in a coherent theory of learning. Their unarticulated beliefs are grounded in the experiences that they have had with their own education. Although the system is at the eye of a storm, the basic beliefs on which the whole edifice is built remain largely unexamined by the public and by vast numbers of educators. Many of the protagonists, therefore, don't know what they don't know. (pp. 8-9)

That began to change when I started reading and talking about curriculum in the master's cohort in the fall of 2000—about the same time the science department was discussing plants and Dirt Babies. One of the assignments for the particular class was to write a term paper on some aspect of the curriculum and then give a presentation with a group over the topic. Fortunately, I was able to get into a group

with some outstanding teachers (including Mr. Elliot, the one whom I heard talk during my first year teaching). As a group we decided we would have our topic revolve around constructivism.

Although I had never been exposed to the idea of constructivism in my college undergraduate classes, I had heard the educational term mentioned several times in my master's courses; each reference seemingly portraying the idea positively. I had recalled the ambiguity of the term from an article by Perkins (2001), and as he explains, "Constructivism does not seem to be one thing. And whatever constructivism is, its advocates sometimes have championed it to the point of overkill" (p. 176). Despite the vagueness of the term, however, it was a concept worth investigating.

As a relatively new teacher, easily influenced by buzz-words, trends, and teachers with impressive titles, I too wanted to be part of constructivism, despite my complete ignorance on the topic. Like many educators, I had never really examined what I really thought about learning. Kohn (1993) describes the company I was in:

> The overwhelming majority of teachers…are unable to name or describe a theory of learning that underlies what they do in the classroom, but what they do—what any of us does—is no less informed by theoretical assumptions just because these assumptions are invisible. Behind the practice of presenting a colorful dinosaur sticker to a first-grader who stays silent on command is a theory that embodies distinct assumptions about the nature of knowledge, the possibility of choice, and what it means to be a human being. (p. 10)

Fortunately, my task with the group was not to explain constructivism and how it influences classroom practices, but instead my task was to explain the history of the idea, something more manageable for someone unknowledgeable about the topic.

As I started reading articles on constructivism (Brooks & Brooks, 1999; Bruner, 1966; Perkins, 2001; SEDL, 1995), I began to get a feel for what it meant to *be* a constructivist. It was not merely something that could be done in the first few minutes of class but an understanding of how people learn and come to understand the world. As I worked with my group members, one in particular, Mr. Elliot, was very fluent in constructivism. He knew what it was and what it meant to him, and he kept talking about constructivism being about "giving students meaningful experiences that allow them to make sense of their world" (personal communication, 2000-2003). He must have used that phrase twenty times if he used it once. It was as if constructivism was something he himself invented. He gave me an article entitled "The courage to be constructivist" (Brooks & Brooks, 1999) and suggested a book that might be helpful to my understanding of the topic. He offered to let me use the book for an example of how one teacher used constructivist ideas when discussing photosynthesis in plants (Brooks & Brooks, 1993)—something my seventh graders were getting ready to study, and something I might want to eventually try with them as they used their Dirt Babies. Even though I obviously wasn't a convert to the "constructivist" camp—I *was not* a constructivist—it would be a good teaching experiment to see how it worked firsthand. However, Mr. Elliot's book and article

would not be the only resources that would give me the courage to try doing things differently in my classroom.

When reading the articles about the history and development of constructivism (Bruner, 1966; Dewey, 1944; Piaget, 1973; SEDL, 1995), I was being challenged to question my methodology in the classroom. The classroom activities that had filled my school days as a student and that were currently filling my classroom as a teacher were, to me, traditionally common and effective—things like reading and doing section reviews and worksheets, doing labs that were already spelled out with an in-depth procedure, and fighting for percentage grades that would round up, such as the coveted 89.6 percent. These 'common' practices were the things I was expecting my students to do. As a student, I felt successful working within a system that used worksheets, section reviews, cookbook labs, and percent grades; I thought those students who were not succeeding in my classroom needed to work harder at the common things their peers and I were able to do.

The more I read and talked to others about constructivism, however, the more I questioned the benefit of doing these 'common' things in my classroom. I wondered if there was a better way to think about learning. Constructivism was starting to make sense, but I wasn't ready to abandon the strategies that worked for me growing up. Although I was doing some 'hands-on' activities in my classroom, the activities were, for the most part, done to keep my adolescent, middle school students awake and involved in my class; it wasn't because they would necessarily learn better or because of some progressive pedagogical idea of learning or epistemological theory. In fact, the activities were mainly done *after* I had given

notes or discussed a topic, as a supplement to what I had already told them. Despite my insecurity as a teacher, I felt a great sense of comfort that I could give my students pages to read, vocabulary to define, and questions to answer, and that these assignments would be sufficient to expose students to scientific ideas and be a supplement to my lectures or class discussions on the topic. I reasoned that because it worked for me when I was a student, it should work for them, as long as they worked hard enough. After all, as I heard growing up, working hard separates the successful from the unsuccessful; I was successful because of my hard work and my students could be successful too.

Even though the constructivist articles were challenging me and my thoughts about education, I wasn't disturbed enough to *really* want to learn what classroom activities may have been ineffective. Like most teachers with whom I worked, I wanted to improve my teaching. However, the constructivist literature I was reading wasn't enough to stop me from assigning worksheets and defining science vocabulary words. It wasn't until I read a science essay that my neurons really started to get perturbed.

I was perusing science literature to feed my hunger for the topic when I ran across an essay that, at first, seemed interesting. The essay was a quick read and was entitled "The wonderful mistake" by Lewis Thomas (1979). As I finished reading, however, I realized the article was much more than interesting; the science essay was something I could apply to my classroom simultaneously with the constructivism activity from the book Mr. Elliot had loaned to me. I had no idea that collectively, both the science essay and the curriculum articles and books would be the impetus for

a process that would challenge my basic understanding of teaching and learning. It made me question my entire view of the world as I knew it.

In Thomas' essay, he discusses the sequence of one cell forming two cells—a vital process if life is to continue on earth. Within that complicated sequence of cell reproduction and division, Lewis hones in on a particular aspect of the process—a process in which the entire genetic code has to be copied so the daughter cell has the same 'instructions' or code as the parent cell—a process called DNA replication. The process is similar to copying an entire encyclopedia, letter for letter, so the end result will yield two identical encyclopedias.

Although the process of DNA replication is extremely accurate, many times a few base pairs (or letters) out of several millions are miscopied. At first glance, argues Thomas, that seems to be an unfortunate event; the mistake, from our perspective, doesn't seem to be a desirable thing for the cells. If humans were to have designed DNA replication, Lewis continues, we might have done all we could to eliminate the mistakes completely from the copying process. We so disdain the idea of messing up or making mistakes that it has become a cultural phobia. We avoid mistakes in the things we design and create. We would have strived to make the process 'perfect.' Upon further investigation, however, it becomes apparent that the mistakes in DNA replication are actually a vital process for life here on earth. As Thomas describes, if scientists would have been asked to design "a similar replicating molecule, starting from scratch, we'd never have succeeded. We would have made one fatal mistake: our molecule would have been perfect" (p. 28).

According to the current understanding in scientific circles (Siebert, 2006; Starr & Taggart, 2004), the slight errors in DNA replication are enough to make some of the daughter cells slightly different than the parent cells—in a word, the daughter cells are mutated. Mutations however, make organisms different in nature; they provide diversity and new genetic combinations that *might* prove to be beneficial. Without the mutations, all life (which began as something similar to a single-celled bacterium) would be the same, and we would not have the diversity of life here on earth. In fact, there would be no diversity at all; every cell would be an identical clone of the original. Most likely, life would not exist at all if mutations were not common. As Thomas (1979) so eloquently states, "The capacity to blunder slightly is the real marvel of DNA. Without this special attribute, we would still be anaerobic bacteria and there would be no music" (p. 28).

As a person who takes great pride in understanding scientific principles, this article hit me hard, like the proverbial ton of bricks. I had heard the old adages "to err is human," and "learn from your mistakes," but it seemed better to me not to make mistakes in the first place. I never saw much value in mistakes, much less thinking they may be necessary for growth. I have no doubt that, during my years preparing to be a teacher, I heard or read about the importance of mistakes and how they could be used to increase student learning, but it never stuck. Despite those encounters, it never hit me like Thomas' article had. Thomas' essay was based on *science*, something on which I placed tremendous value. The educational articles I read or my discussions in the past never reached that part of my mind I placed value—that of scientific understanding. Thomas' article not only discussed learning from mistakes,

but also described how mistakes are vital in life, and all from the current scientific understanding of how nature works.

During my years as a student, I had personally tried to avoid mistakes, to avoid blood-red marks on tests, quizzes and homework assignments. It was counter-intuitive to view a mistake as a necessary part of life, and worse, a necessary part of education. I assumed one of my jobs as a teacher was to keep my students from making mistakes—to foster an environment of error-free work. Thomas' article made me seriously question what I should be doing in my class with students and their errors (or the quest for a lack of errors).

Adding to Thomas' article were the constructivism articles and books I was reading (Brooks & Brooks, 1993; Brooks & Brooks, 1999; Bruner, 1966; Dewey, 1944; Perkins, 2001; Piaget, 1973; SEDL, 1995). They questioned how much learning was occurring if a teacher was telling the students how to solve problems or explaining to pupils exactly how to do experiments—not allowing students to make some mistakes. Despite my very rudimentary understanding of constructivism, the Thomas article fit nicely with what I understood constructivism to be. Students taught using constructivist methods would make many mistakes, and those mistakes would help students understand concepts. I thought about how my students and, maybe more importantly, how *I* would respond to a classroom that allowed, and maybe even welcomed, mistakes.

The Dirt Baby experiment was an ideal starting point to see if student mistakes could work in favor of learning, and more significantly, if I could tolerate a classroom or laboratory that wasn't as clean, organized, and efficient as I was

accustomed to. Also, there was one other seventh grade science teacher whom I admired, who was allowing her students the freedom in lab to do the experiments as the students saw fit—to make some errors. Even though I admired her teaching, her classroom was somewhat chaotic, and I thought she should have more control over her students. Because of my uncertainty about how much input and advice she gave her students, I talked with her about how she managed her classroom and her labs. In talking with her, she suggested that she didn't give her kids total freedom in lab, but she did appear to give the students more freedom than I was willing to give. I needed more control over the classroom and laboratory environment.

As much as I may have desired, I wasn't willing to let the students have anything close to complete freedom in designing their experiments. I devoted several class periods before the start of the experiment to talking about the basics of how plants work, mainly to ease my anxiety about letting them loose in lab without understanding the basics. But, I didn't talk much about experimental design. I would provide minimal help to the groups with their designs while they were discussing how they wanted to do their experiments. I would keep my opinions about the validity of their experiments to myself as much as possible. I attempted to guide their thoughts, and at times I told several groups that their experiments were not going to allow them to answer the experimental question. I just could not stop myself from interjecting.

For example, the experiments were attempting to answer the question "How does the amount of light affect the height of grass?" It surprised me to see how many groups had experimental plans with too many variables or plans that didn't have a control to test their plants against. There were groups that only wanted to grow their

seeds in the dark with none in the light; there were other groups that wanted to have some plants growing in the dark getting watered with saltwater, some plants in the greenhouse getting watered with tap water, and some plants in the fluorescent lights of the classroom getting watered with water and food coloring. I didn't have enough self-control to not intervene; it was too difficult to let the student experiments fail miserably. Even if the students did the experiments as they had planned, there was no way for them to answer the question with such poor experimental design. However, I did force myself to close my mouth more often and let student ingenuity reign.

Because the plant experiments would be done over several weeks time, I continued the plant unit while the students collected data on their Dirt Babies. One of the lessons I decided to do in the interim was an activity from Mr. Elliot's book on constructivism (Brooks & Brooks, 1993). Although I understood a person *was* a constructivist and couldn't just *do* constructivist activities from time to time, I was still trying to decide what I thought about the whole notion; by doing a constructivist activity it would help me decide. The constructivist activity centered on the process of photosynthesis.

Photosynthesis is a process that is vital for life on earth, and a process I felt all students should learn (and my seventh grade science colleagues agreed). The process on paper is quite simple, and as a science teacher, the textbook explanations seemed adequate with some additional explaining by me, the teacher. The book Mr. Elliot loaned me discussed the way many teachers teach photosynthesis; I could see myself teaching in a similar manner. The teacher would use a combination of textbook work and demonstrations to get the students to learn about photosynthesis. The teacher

talks about "the role of chlorophyll and presents the chemical equation for photosynthesis: $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$. …Students commit new information to their short-term memory for the purpose of mimicking an understanding of photosynthesis on an end-of-chapter test" (p. 18). Although I would *expect* my students' understanding to go well beyond their short-term memory, I realized many test questions would not assess if students did more than memorize the chemical equation by putting it into short-term memory. In effect, a student could have committed the process to memory for the test, scored very highly on the test, but missed the entire *significance, meaning, and true understanding* of the overall process.

The constructivist example from the book took an entirely different approach to teaching photosynthesis. The activity, which was an example of a lesson being done by a Ms. Martina, didn't even *mention* photosynthesis until the second day of class. "Ms. Martina, not only deleted the molecular equation and references to cell walls in her introductory lesson plan, but actually deleted all references to photosynthesis" (p. 18). Instead of talking to her class about photosynthesis, she asked her class to describe processes that start with raw materials and, once combined with an energy source, create a product and a by-product. Examples would include taking malt, milk, and cocoa, applying electrical energy from a blender to produce a milk shake. The by-product, which was difficult for some of Ms. Martina's students to come up with, might include dirty dishes and even an "appetite-wetting aroma" (p. 19). As the students and Ms. Martina discussed the processes, they would not initially focus on chemical formulas or equations, but on a system that utilized raw

materials and energy to produce both products and by-products. Only after her students did this activity did she mention photosynthesis and how that process was similar to what they had just described from their own life experiences.

As crazy as it might sound, I actually learned more about photosynthesis from reading Ms. Martina's activity than in all my years taking science classes. I never had the mental image of photosynthesis being similar to making a milk shake. I never thought of carbon dioxide and water being raw materials in a process that used light energy to make sugar and, in the process, forming a by-product of oxygen. Although I had memorized the complex biochemical reactions of photosynthesis, I didn't understand the process at the most basic level, which was what Ms. Martina was doing in her classroom—not trying to get her students to understand the biochemical reactions, but to understand the basic process. As Brooks and Brooks (1993) describe:

> Though Ms. Martina's students didn't construct a biochemical understanding of photosynthesis, and their examples were not completely analogous to the system of photosynthesis in terms of reversibility and complexity, they did begin to appreciate that one way of trying to understand photosynthesis is as a systematic process yielding both a product and a by-product. This understanding can serve as a basis for the construction of a more sophisticated understanding of photosynthesis and the ability to use the unit's vocabulary. (pp. 20-21)

After reading through the activity, I was confident it would help my students understand photosynthesis. So, before discussing the details of photosynthesis, I had

the students work in groups to come up with several processes that use raw materials and an energy source to make a product and by-product. I was encouraged by the diversity of processes the students discussed. Some were talking about the process of building a house, others making a peanut butter and jelly sandwich, and others even more complex processes like building a car. All of my seventh grade students I was capable of observing were able to think of at least one process, although I had to walk a few of my students through more examples until they came up with their own. We then had a class discussion and talked about many of their ideas. At the end of the class period, I had not mentioned photosynthesis. However, I felt my students had a good understanding of some common processes they could use later to understand it.

The next day in class, as we began to talk about photosynthesis, my students and I continually referenced the processes they had described the previous day. As a teacher discussing this complicated process, I was more confident because I could relate the complex process that occurs in a plant to examples from the students' own work, like making a peanut butter and jelly sandwich. I was also excited because of my own new understanding and appreciation of the process. Unfortunately, because I never taught photosynthesis before, I could not compare the results to any previous method. Despite that uncertainty, I was enthusiastic about the constructivist activity's relation to our plant unit, *and about what I learned* about carbon dioxide, water, glucose and oxygen. Throughout our entire plant unit I referred back to that activity many times when talking about what a plant does while in the sun. I knew the activity was successful at helping students understanding plants, even though I had nothing with which to compare.

As the plant unit was winding down, I was not able to do any more constructivist activities simply because I couldn't think of any. Even when talking to the other science teachers, none of the activities or lessons they suggested appeared to be as simple or relevant as the one I used; the activities weren't allowing students to draw from their own experiences to truly understand plant concepts. However, the student's plant experiments were drawing to a close and I asked them to write a lab report of what they did and what they learned by doing the experiment.

I didn't have a clear idea of what I wanted my students to write about, so I went with a simplified version of what was required when I was a student in college, the typical five-step scientific method—problem, hypothesis, procedure, results, conclusions. Just like the most of the other work I assigned, it wasn't because of an insightful theory of learning, but because that was the way I experienced it in my science classes (college classes especially held weight in my mind since they were the experts/Ph.D.'s in the subject).

When I started reading the reports my students submitted, I wasn't impressed. The students didn't think about what they did or what happened in their experiments. Even though I tried to emphasize the importance of being thorough in the reports, based on what I was reading I didn't feel they learned as much as I had hoped, especially in those groups who were making errors. Despite having lofty expectations of how their experiments would help them learn about plants and about scientific investigations, I was somewhat discouraged. There was not one report that was written as in-depth as I had expected; there were only a handful of papers that even discussed their mistakes and how to correct them if doing the experiment again.

Although I had this great idea about how mistakes could be beneficial, this first experience was not living up to my expectations.

So I decided to talk to my classes about their experiments and how they would evaluate their work (both the experiments and the reports); I reasoned that many students may have learned more during the experiments than what they wrote in the lab report because of a dislike of writing. A class discussion would allow them to do less 'work' in explaining their experiment and maybe even allow them to get more out of the experiment. As we discussed the experiments, my students and I were able to reference things from their experiments that worked and those things that didn't. As I listened to them, I began to understand that they got more out of doing the Dirt Babies than what they put on paper, especially when they were questioned about how they could have improved their experimental procedures or how confident they were in the accuracy of their data. It was almost as if they preferred to talk about their work instead of writing about it.

I also found it beneficial to ask groups direct questions about their methods to see if they could defend what they did; the class discussions turned out to be a great way for them to learn about the scientific method and how to set up experiments that tested only one variable. The students' direct experiences with their own inaccurate investigative methods became a great learning tool.

After the class discussions, I was more confident about how my students could learn from mistakes. Although I had hoped they would have discovered and written more about those errors, I did get a general sense that mistakes could indeed be beneficial, especially when used in a productive class discussion. However, just

like the constructivist activity, I was at a loss to come up with other ways to use student mistakes to their advantage—to make those mistakes a learning tool. My lack of creativity appeared to be my greatest obstacle in implementing these new educational thoughts of mine; I just could not think of alternatives to the way I had been taught.

CHAPTER 10

LEARNING SCIENCE

As the fall semester was wrapping up for me as a student in the master's program and as a teacher of hormone infested seventh-graders, I was somewhat frustrated I could not apply more of what I thought would work in a classroom (my theory, which was becoming more constructivist the more I read) with what I was doing in the classroom (my practice, which was still more like the traditional classrooms I was exposed to during my schooling). I wanted to try new things, but I couldn't think of new and different things to do. Even in collaborating with the other science teachers, nothing seemed to compare with the photosynthesis activity. I wanted to have more activities like the photosynthesis one, but I wasn't able to create any.

I felt similar to Inchausti (1993) as he talked to Brother Blake about how ideas can oftentimes be difficult to implement. Brother Blake had asked Inchausti how to get from a mark on the floor to a similar mark six feet away. Just as I might respond, Inchausti explained that he would just walk. Brother Blake took the opportunity to challenge Inchausti, and in turn challenge me:

> "No," he said. "You do this!" and then he walked over to the large mark. "You do it!" he said. "You don't *say* how it is done. That's the trouble with intellectuals—they have minds but no hands or feet. They lack the capacity or the desire to do the work their insights reveal to them must be done, so they write books on why life is impossible…." (pp. 88-89)

Intellectually, I felt challenged by what I was learning, but I couldn't put my feet to the pavement; I could describe how to walk from point "A" to point "B," but I lacked the physical skills to do it. Despite my feeling of inadequacy about implementing my thoughts on education, I did, however, still have a strong faith in my science background and scientific understanding. Even though I learned more about photosynthesis from a book on pedagogy than in all my years in science classes, I was secure in my knowledge of science. If anything, I was more confident in my scientific understanding than in what I knew about teaching and learning, especially after not being able to come up with anything like the constructivist activity on my own to do in the classroom.

As I received the syllabi and schedules for the spring semester master's classes, I noticed one of the classes, "Systems Theory and Learning Organizations" actually had required readings from what seemed like science literature—books like *Chaos: Making a new science* (Gleick, 1987) and *Leadership and the new science* (Wheatley, 1994). Up to this point in my educational journey, I had never taken a 'teaching' class that included science in it. I did however, become very interested in this class not only because of my attraction to science, but also because of what I experienced the previous semester with Thomas' essay "The wonderful mistake" (1979). I wanted to apply more scientific ideas and concepts to my teaching, but Thomas' mistake concept was the only thing so far I had been able to think of, and I was only able to apply that once to a lab that didn't live up to my expectations. I wanted to apply more scientific principles to my pedagogy.

One of the first assignments was to read selected chapters out of James Gleick's book *Chaos: Making a new science* (1987). The first chapter reading was entitled "The Butterfly Effect," and it described how Edward Lorenz, a meteorologist, accidentally stumbled upon an idea about the accuracy of weather prediction; the discovery challenged some of the foundational ideas of physics. The story of his fortuitous discovery turned out to be quite humorous.

In the 1960's, Lorenz was working with a computer that simulated and modeled certain weather conditions that could span several months time—a machine that "succeeded in mesmerizing his colleagues. Every minute the machine marked the passing of a day by printing a row of numbers across a page. If you knew how to read the printouts, you would see a prevailing westerly wind swing now to the north, now to the south, now back to the north" (p. 11). The weather-toy seemed somewhat of a novelty to others in his office, especially since "in the 1960's virtually all serious scientists mistrusted computers" (p. 13).

One day while running some simulations, Lorenz decided to take a shortcut. Instead of running an entire sequence over again, he started the particular sequence midway through. He fed the conditions into the computer from a printout of a previous run, and then walked down the hall to get some coffee. This seemingly insignificant trip down the hall would turn out to be an event that would change Lorenz' life. As Gleick describes, "When he returned an hour later, he saw something unexpected, something that planted a seed for a new science" (p. 16).

Lorenz thought this new run should have duplicated the old, but to his surprise, the computer graph showed that within a few months no resemblance

remained—the weather model indicated a dramatic change. He double-checked his numbers for accuracy and found he had entered the numbers accurately with one exception. He entered numbers that went to three decimal places; the initial graph had used calculations that went to six. He had used the number .506 instead of .506127, assuming the difference of one part in a thousand would be inconsequential. As it turned out, the weather patterns began at the same point on his graph and continued on a similar path, but "by the time the two runs reached the [second] hump, they were distinctly out of phase. By the third and fourth hump, all similarity had vanished" (p. 17).

It turned out that a simple error for Lorenz had huge implications for science and weather forecasting around the globe (I could hear Lewis Thomas exclaiming "*What a wonderful mistake!!!"*). Up to that point my idea of science worked from the philosophical assumption that, as Gleick describes, "Given an *approximate* knowledge of a system's initial conditions and an understanding of natural laws, one can calculate the *approximate* behavior of a system" (p. 15). Lorenz' model demonstrated the impossibility of completely predicting the weather (or any other phenomenon) because there is no way to know, with accuracy, all of the initial conditions. Even if you could put weather stations six feet apart across the entire face of the globe and make them accurate to the nearest ten-thousandth of a degree, it would not be enough to predict weather conditions over long expanses of time. One might be able to make *more accurate* predictions, but one could never be completely certain about any forecast.

As I read the first chapter about the Butterfly Effect, I felt as puzzled as when I read Thomas' essay about mistakes. This information was different from what I understood about the world and science, but I wasn't able to put the pieces together. The Gleick chapter was challenging me, but I wasn't sure how it applied to my teaching or to education. Although I read the entire chapter, the story of Lorenz and his computer error had captured my attention; the remainder of the chapter was too obscure. I wondered if I was missing something by focusing on Lorenz' story.

I completed the remainder of the readings and reflective essay assignments that went along with each reading, but nothing intrigued me like the Butterfly Effect; I wondered why I couldn't synthesize the *Chaos* book with any of my educational ideas.

When I arrived for the first class, which happened to be on a Friday afternoon after a long week of teaching, I was excited to dig in. I wanted to understand how I could use this new information in my classroom. As with the other graduate classes I had taken, however, I would have to wait through the typical introductions of students to teacher and visa versa. I never particularly enjoyed that part of any class; I guess my attitude about classroom time was that it was supposed to be for the 'business' of learning and not the fluff and congeniality introductions inherently create. That is how I tried to structure my classroom and that is how I thought all classrooms could use time most efficiently and productively.

As the introductions and greetings came to a close, the class focus shifted and we began talking about metaphors and the ways in which we teachers perceived education. As the discussion evolved, I realized I probably had metaphors about my

classroom and about teaching; however, I wasn't sure what they were. I could rattle off some packaged answer with teacher lingo that sounded nice, but I wasn't confident that it would accurately describe what I truly thought and did with my students. Because of my readings from Wong and Wong's book (1998) about procedures and routines during my first year teaching, if I had to create any metaphor for my classroom, it would be a well-oiled machine. My students knew the expectations and the procedures, and my classroom functioned smoothly and efficiently; there were few disruptions to my teaching. That was the best I could do with the metaphor. It wasn't very impressive, but I liked the idea of my class being like a machine. As the evening class came to a conclusion, however, very few of my thoughts had been clarified. There wasn't much talk about Lorenz and his computer error or any of the other readings we had done. If anything, when class ended that evening I felt more confused about what I knew about education.

The remainder of the classes that weekend, both Saturday and Sunday, was more encouraging; things began to make more sense. We started discussing the Butterfly Effect and how it could relate to education. Someone began describing a particular application of the name "Butterfly Effect" to weather; the explanation was startling.

According to what the classmate researched, one interpretation of the Butterfly Effect was that a butterfly flapping its wings in Asia could cause a hurricane on the other side of the globe. A seemingly insignificant event in one environment could, in theory, have drastic effects on global weather patterns. At first glance, the notion sounded absurd. However, using Lorenz' mistake with his weather computer,

it made sense. Little, 'inconsequential' actions could indeed change the course of events forever, just like Lorenz' decimal mistake had shown.

As my classmate described that interpretation of the Butterfly Effect, another classmate, one known for being somewhat sarcastic and loud-mouthed, chimed in stating, "How could my stepping on a piece of grass change anything about birds in China?"

Being excited about this knew piece of knowledge about the Butterfly Effect, and wanting to put the loud-mouth in his place, I responded to his question—and responded quickly and matter-of-factly.

"You never know how your actions could affect things around you. We *think* we understand how our actions influence the future, but we could be clueless!"

Being his usual self, he couldn't let anyone get the last word. "One blade of grass will not make a bit of difference!"

"But you don't *know*," I exclaimed. "That piece of grass may have been in the perfect position for some grasshopper to land on and consume. You may have disrupted the insect's life, which could have, in turn, affected birds and even caused more competition for birds that migrate to China, which in turn, could have caused some of those birds to die prematurely. The whole point is *we don't know for sure* how our events could change the course of history!"

Deep down, I wanted him to respond so I could expose his ignorance about science; fortunately, he conceded and the discussion shifted beyond the argument about whether an Asian butterfly could actually cause hurricanes in North America.

After the exchange, I was confident he understood my position. After all, I was a science teacher, and he taught language arts and history. But there wasn't an application of the Butterfly Effect to the classroom, yet. As the class continued to talk about the butterfly in Asia and hurricanes in Florida, the discussion shifted to how it might relate to education and teaching. The person who had originally talked about butterflies in Asia began discussing how he thought it fit into his classroom and his teaching practices. "Anything and everything I do influences my students to some extent; all of my actions have consequences. Do I know what those consequences will be? No. But, I try to interact with my students with the understanding that something small on my part may cause huge changes in their lives—both good and bad."

The loud-mouth whom I had just put in his place began to chuckle, "Yeah right! You really think that by telling Johnny to sit down and get to work that it will really have an impact on him when he is seventy-five years old?"

I felt the adrenaline shoot through my veins; I had another chance to put him in his place. I didn't particularly like confrontation, but something about this classmate just got under my skin. Each time he opened his mouth, I just looked for some error in his reasoning. I had to let him have it on this comment.

"Of course it can," I said. "We always think about how the *big things* we do cause others to change, but we never even think about how small things can affect someone. Just like Lorenz' weather model computer demonstrated, the little things can have a huge affect on the future. And just like the grass in your front yard and the birds in China, we never know how our actions could cause things to change—either

negatively or positively. We have been used to thinking that the little things don't matter, but maybe they matter a lot more than we realize. Besides, could it hurt to have this kind of thinking when interacting with students?"

I could see his grin as I lit, but his response was rather anticlimactic. "I suppose."

The exchange had ended; I made my point and felt confident in how I applied the Butterfly Effect to my science classroom. The cohort classroom mood shifted, however, as others began to think about their own schooling experiences; they then began sharing about their own educational histories. They talked about how they had experienced things in school, little things, and how those little things were still fresh in their minds as adults. Almost every person in the room could remember one particular event in their schooling—an event that others might have viewed as seemingly insignificant—that influenced their life. The small incident from their early schooling days ended up being very significant, even now as an adult. As the cohorts chatted, I contemplated how the Butterfly Effect would change my classroom.

I never tried to intentionally demean or cause emotional harm to my students, but as I reflected on my actions as a teacher, I thought of several examples of things I had done that could have been harmful to my students. I thought about those times I asserted my authority during the first few weeks of a new school year; in my attempt to be stern and direct to students who were pushing the limits, I might have responded too harshly. I also wondered about how I affected students in my classroom who tried to turn in 'late' work.

I never allowed my students to turn in work past the due date—no exceptions; it was one way of making my students accountable for their actions. However, by focusing on student accountability, I missed out on what I was doing to the student beyond the academics of school. The master's cohorts discussed how they had had students come to them with stories of physical or social abuse, and how those situations didn't allow the students to complete their homework. My classmates explained that many of these students don't share the real reasons for incomplete assignments, so they either take a zero or make up other stories to cover-up what is really happening at home.

In my classroom on several occasions, I had made statements to my students such as "I don't accept late work, no exceptions" or "If an assignment is due today at the beginning of the hour, then that is when I expect it to be done and turned in, not tomorrow. You need to be accountable and responsible for your work." I never imagined the range or extent of reasons for missing or incomplete assignments, partly because I had never experienced problems at home. My parents were supportive and they valued education. They let me know, however, that I was responsible for my education; they would help if I needed it, but the brunt of the responsibility fell on me. Personally, now as a teacher, I could not envision home environments that would force a student to appear irresponsible in school. Even for a well-meaning student who wanted to do the work and be responsible, the home situation may work against those desires.

As my brain poured over all the possible harm I could have caused my students, I took solace that, despite the harm I might be causing, I wasn't the worst.

There were others who did things inconceivable to me. I had yet to assign a detention to any of my students, but I knew teachers who used detention early and often as a means to control and instill fear in their students. Detention was too removed from *my* classroom; I wanted more control. As I contemplated how bad I could be as a teacher, my thoughts shifted from analyzing every aspect of my teaching to how a science idea could be used in teaching.

I had attempted, without much success, to allow students to make mistakes with the hopes that those errors could be used for learning. With the Butterfly Effect, I could see how this concept could directly apply to what I did in my classroom. I wanted to view my classroom, not as a well-oiled machine, but like a weather system—each action of mine being responsible for some change in the future. The Butterfly Effect whet my appetite for more of what this 'systems' class had to offer; I wanted to learn more about how other science concepts could apply to my teaching.

The first weekend of the systems class ended with thoughts of weather precipitating in my head. I envisioned aspects of science being applied to teaching, but I wasn't satisfied with only one concept; there had to be more ways to apply science ideas to classroom structures. The readings the professor assigned for our next weekend class would provide a chance to do just that. Maybe more importantly, however, these readings would not only force me to question my teaching methods, but also my entire worldview.

CHAPTER 11

FOUNDATIONS OF MY EDUCATION

The first part of the next weekend class was focused on Margaret Wheatley's book *Leadership and the new science* (1999) and readings we students chose on our own; I chose to read two books by Fritjof Capra—*The web of life* (1996) and *The turning point* (1982). Reading through the books and discussing Wheatley's and other authors' ideas in class, I was surprised at how much science I didn't know. The first epiphany came as I read and we discussed modernism and the mechanistic model of the Universe.

From elementary school, I knew the name Isaac Newton, and as I progressed in school, his name became more familiar. I wasn't sure, though, why he was so important. In my undergraduate studies, his name came up several times, especially in my physics classes (Hecht, 1994), but I never truly understood his importance to how I viewed the world, much less to education and teaching. While reading and discussing his importance to the world and to science, I began to understand some of my foundations, some of the reasons I thought the way I did.

For one, most people (and organizations) work from an understanding based on mechanistic ideas about the Universe and how it functioned—a model akin to perceiving the universe as a machine. As Capra (1982) explains:

> The Newtonian theory was able to explain the motion of the planets, moons, and comets down to the smallest details, as well as the flow of the tides and various other phenomena related to gravity. Newton's mathematical system of the world established itself quickly as the correct theory of reality and

> generated enormous enthusiasm among scientists and the lay public alike. The picture of the world as a perfect machine, which had been introduced by Descartes, was now considered a proven fact and Newton became its symbol. (p. 67)

This deterministic or modernist understanding of the world operated under the assumption that the world was most like a machine. "Machines function according to linear chains of cause and effect, and when they break down a single cause for the breakdown can usually be identified" (p. 269). A person could best understand the whole machine by understanding the pieces; if these pieces malfunctioned or broke they could be replaced and the machine would continue to run smoothly. Wheatley (1999) expounds on this idea, "This machine imagery leads to the belief that studying the parts is the key to understanding the whole. Things are taken apart, dissected literally and figuratively, and then put back together without any significant loss" (p. 10).

Reading both Capra and Wheatley I understood why I liked the 'well-oiled machine' metaphor for my class. As a student of science (and even as a person living in the Western world), I understood that matter was composed of individual subunits, and that these subunits were as predictable as the planets and other celestial being. If a person/scientist knew more about the location, mass, and directional movement of objects, he/she could know more about the system as a whole. It was how I understood science and the world; it was how I understood my classroom. The more control and knowledge I had about the details of my students' actions, the more I could control what occurred in my class; in effect, my students were individual parts

to a large classroom machine. If one of those parts was malfunctioning, I assumed by fixing the part, I could fix the whole; that helped explain why I desired to control my students the way I did. But the application of the mechanistic worldview to my classroom didn't end there.

I also believed that an objective perspective of the world guided science and scientific knowledge was the only 'True' knowledge. A scientific understanding of the world was the most accurate and precise view of the reality of the world. In the classroom, the teacher was a scientist of sorts, who objectively evaluated the progress of student learning, just as a scientist would objectively measure and observe different aspects of an experiment. The stoic, contemplative professor I had had in my undergraduate work epitomized this perspective of teacher/scientists. He seemed completely objective in his views, and he appeared to value science as the most accurate way of viewing the world. His likeness and demeanor reinforced my view about science being objective and classrooms being well-oiled machines.

As I read through Wheatley's and Capra's views of mechanistic science, however, I questioned objectivity and reality as well. Both talked about experiments done in the early 20th century on one of the smallest 'parts' of the atom, the electron, and how those experiments were turning the idea of an objective observer and reality on its head.

Electrons, along with protons and neutrons, are tiny subatomic particles of the atom most people learn about at some point in their common school experience. Many have been taught that the electron orbits around the nucleus, which is composed of the protons and neutrons (McMurray & Fay, 1995; *Science Horizons*,

1993). However, electrons don't behave like most people would expect. Electrons can be observed functioning like a wave (dispersing energy over an area) or like a particle (specific points in space); they have a duality that allows them to have either characteristic (Hecht, 1994; McMurray & Fay, 1995). In one experiment, the duality of the electron particle was tested to see how it would respond. The electron was sent towards a surface that had two openings or slits in it. On the other side of the openings was a second surface where the electron landing could be recorded as either behaving like a wave or like a particle. As the electron passed through the opening, however, something strange happened. As Wheatley (1999) explains, "If both slits are open, the single electron acts as a wave, creating a pattern on the recording screen typical of the diffusion caused by a wave. If only one slit is open, the resulting pattern is that of discrete points, or the behavior of a particle" (pp. 63-34). The electron acts as if it 'knows' if the other slit is open or closed—if the scientist is trying to observe a wave or a particle. Even "[i]f the observer tries to 'fool' the subject by opening and shutting slits as the electron approaches the wall, the electron behaves in the manner appropriate for the state of the holes *at the moment* it passes through" (p. 64).

These observations fly in the face of a mechanistic understanding of matter. Particles shouldn't 'know' what is happening around them; a scientist's observations should not influence the outcome of the experiment. This new quantum understanding of the how the world operated was so counterintuitive that it changed the way scientists understood the world. Capra (1982) describes this shift:

> The crucial feature of quantum theory is that the observer is not only necessary to observe the properties of an atomic phenomenon, but is necessary even to bring about these properties. My conscious decision about how to observe, say, an electron will determine the electron's properties to some extent. If I ask it a particle question, it will give me a particle answer; if I ask it a wave question, it will give me a wave answer. The electron does not *have* objective properties independent of my mind. In atomic physics the sharp Cartesian division between mind and matter, between the observer and the observed, can no longer be maintained. We can never speak about nature without, at the same time, speaking about ourselves. (pp. 86-87)

The electron experiment, as well as others done on similarly small particles, called into question the notion of a Universe that could be measured and observed objectively and precisely (fitting in nicely with the ideas I had come to understand using the Butterfly Effect). One of Descartes' contributions to an understanding of the world, the one I understood and used, was that it could be best understood by understanding the component parts. Similar to the machine metaphor, many refer to the mechanistic worldview as 'the clockwork' Universe (Capra, 1982; Wheatley, 1999). If more is known about the parts to a clock, we can understand more about the whole clock; the more we understand about the pieces to the Universe the more we can understand the whole Universe. But, as the electron experiment showed, even one of the smallest units of the atom is influenced by the observer. How can we expect to truly understand the universe if our observations influence subatomic particles?

The electron experiments also call into question the notion of an objective observer. How can we trust our 'objective' observations about the world if we influence electrons just by trying to observe them? We can no longer think about reducing things to their most simple components to understand them (which is a hallmark of mechanistic thinking). According to what the new science is showing reductionism is not be the best way to understand the world. In fact, the quantum experiments of the early 20th century demonstrated that science can't be certain, which is summed up in an aptly named principle— the Heisenberg Uncertainty Principle.

In my undergraduate work, I took several science classes that discussed the Uncertainty Principle, and I thought I understood the concept. In fact, if a person were to ask me about it, I could have given a reasonable answer—one that would agree with a typical physics textbook explanation (Hecht, 1994). However, I failed to understand what it meant *about* science and the nature of the Universe. The principle states that an observer cannot know both the location and velocity of a particle with complete certainty; either the velocity or the location can be known, but not both simultaneously. If you try to observe one accurately, your observation makes the other measurement inaccurate; in effect, by observing the particle, you will change it. This principle is reinforced by the experiments done on electrons, but I never applied the principle to my life beyond an understanding of subatomic particles.

As I read about the clockwork Universe, electron experiments, and this seemingly simple principle in Wheatley's and Capra's books and as we discussed the ideas in the weekend class, the scientific principles became more than just concepts in

science. I began to understand certain things about my teaching and my life I never really understood before.

To begin with, I thought as a teacher I could observe and evaluate my students with precision and accuracy; the grade on their paper was an accurate reflection of what they knew. Students' knowledge was quantifiable, and it was the teacher's job to give students numbers that would then correspond to a letter grade. There was little or no question in my mind that grades were a valuable and even essential part of teaching, learning, and education. In a way, I thought of my classroom as a science experiment. The teacher was the observer, collecting numerical data on each student, much as a scientist collects data in a laboratory, and then reporting that data to the students and to the parents. Because of this view of grades and my idolization of science, I didn't doubt my observations about my students. They were completely accurate; I knew the Truth about my students.

With a new application of the Uncertainty Principle, however, my confidence in my observations began to wane—drastically. I questioned how much of my observing was actually influencing my students, and even the validity of those observations. If a scientist influences the smallest pieces of matter solely by observation, it stands to reason that my observations must influence my students. Simply by observing my students, I was changing them; I could not be an objective observer of the kids in my classroom.

With this new understanding, the whole notion of an accurate grading system flew out the window; from what I was beginning to realize, there was no such thing as an accurate grade. I wondered how I could even evaluate my students. How I

could put numerical grades on papers they gave to me? My once prideful view of percentages and letter grades was all thrown into doubt. Students in my classroom who had received an eighty-nine percent were given a 'B' because I placed such high value on numbers and quantitative data. Now I was questioning how accurate *any* of my grades were.

The ironic thing about my whole experience with the mechanistic clockwork Universe and the new quantum science was that science itself was demonstrating it was uncertain. Up to this point in my life, I valued scientific knowledge because it was "scientific"—the only True way to know the world. The new science was showing me that science is uncertain also; in fact, there is no way to be certain. Where I had previously scoffed at the idea of an uncertain science, I now understood it was true, and it was because of science; science was proving to itself that it could not find 'Truth.' Before the systems class we cohorts endured a qualitative research class that didn't make sense to me; I felt like I was trying to climb a greased flagpole. I doubted things could be known with certainty without the use of numbers and a strong scientific method to follow. I did not particularly enjoy reading and trying to understand qualitative studies that lacked numerical data. I thought they were inaccurate and of little worth. I knew the Truth about how the world could be understood and the qualitative research class was a waste of my time. Now the qualitative research class made more sense. As Merriam (1998) explains, "The key philosophical assumption…upon which all types of qualitative research are based is the view that reality is constructed by individuals interacting with their social worlds. Qualitative researchers *are interested in understanding the meaning people have*

constructed…" (p. 6). There was value in looking at the world without the goggles of mechanistic science.

I also understood the structure and organization better. The only schools I had been involved in were ones that separated knowledge into pieces or content classes. I never thought about why schools were structured this way; I assumed that knowledge was always perceived as parts to a whole. However, it seemed that schools were built upon the clockwork metaphor; students went to different classes because those classes were pieces that, when combined together, would make a complete whole. In my classroom, my role as a science teacher was to impart the science component of the curriculum to them; they would go to other classes to get the other pieces. I could not conceive of schools and knowledge any other way.

As the final systems class wound down on Sunday night, I felt like I had learned more about myself in those three days than I had learned my whole life. I understood the 'why' behind my thoughts and actions; I understood my foundations. As I hit the pillow that night to get some rest for the following day in my own classroom, thoughts about my own life kept me awake. I slept very little that night knowing what I did about my life. I was truly excited about the knowledge I had gained, but it was also extremely upsetting. As a twenty-four year old, I felt my life up to this point had been a waste. I had lived my life comfortably and I had taught confidently because of what I thought I understood about science. What I learned in the last three days of my life was that I didn't have a clue about science and how the world operated. The foundation of my teaching, my relationships, and even my life were built upon a faulty slab. I had to face the notion of trying to destroy the old

foundation and rebuild anew. The Herculean task kept me awake virtually all night. I had no idea how this new science would impact my life, but I knew it had to. I couldn't know what I did without having a drastic change in most, if not all, areas of my life. My desire to apply scientific ideas to my classroom (like mistakes and the Butterfly Effect) went much further than the four walls of my science classroom. I understood more about the world, about the mechanistic world, but I wasn't comfortable with how it would change me. These new ideas, while challenging me to change, left me wondering *how* I would change, or more precisely, how *it* would change *me*. Without ever having viewed life with non-mechanistic goggles, I was unsure about how I would change as a teacher, husband, son, brother, and friend.

CHAPTER 12

SEARCHING FOR ANSWERS

As a final project for the systems class, we were required to write an essay that related to some aspect of the class. There was no doubt in my mind I wanted to focus on the new science and how to apply it not only to my view of the world but also to my teaching. I also wanted to find something that would help me rebuild my foundation in life and in education. I began by delving into Capra's and Wheatley's books once again.

As I read the books the first time, I was mainly focused on understanding the mechanistic worldview. I was trying to understand my foundation and not necessarily looking at rebuilding it. It is similar to what occurs when remodeling a house. You first must understand what you have, and then you can go about dismantling and rebuilding anew. The first time through the books, I was trying to find what was there. Now I was trying to see how I could demolish and rebuild. Several words kept appearing again and again—relationships, systems, process; they gave me my first hint at what needed to be done.

The first thing I focused on was my perspective of the notion of parts instead of relationships. As the electron experiments had shown, it is impossible to be an observer without influencing what you are observing; there is no such thing as a truly objective observation. Instead, an observer should not focus so much on the parts being observed as much as on the relationship among the parts of the system, of the observer to the phenomenon, as well as on the system as a whole. The focus should not be on the parts in isolation, but on the system or process in its entirety. As Capra

(1982) explains, "Indeed, the 'new physics,'…is very close to general systems theory. It emphasizes relationships rather than isolated entities and, like the systems view, perceives these relationships as being inherently dynamic. Systems thinking is process thinking; form becomes associated with process, interrelation with interaction…" (p. 267). And as Wheatley (1999) states:

> To live in a quantum world, to weave here and there with ease and grace, we need to change what we do. We need fewer descriptions of tasks and instead learn how to facilitate *process*. We need to become savvy about how to foster relationships, how to nurture growth and development. All of us need to become better at listening, conversing, respecting one another's uniqueness, because these are essential for strong relationships. The era of the rugged individual has been replaced by the era of the team player. But this is only the beginning. The quantum world has demolished the concept that we are unconnected individuals. More and more relationships are in store for us, out there in the vast web of life. (p. 39)

Over and over, the authors made these types of statements, with an emphasis on relationships, process, and systems. They discussed how systems thinking is similar to environmental and ecosystems thinking. A person cannot get an accurate view of complex ecosystems by simply exploring the individual parts; the parts must be viewed within the context of their interactions and relationships within the system.

The more I read those words—relationships, process, and systems—the more I related them to what I needed to do in my classroom. And it wasn't that I *wanted* to be different as a teacher as much as that I *needed* to be different as a teacher. The

mechanistic model of the Universe had unknowingly dominated my classroom practices, and now that I understood the new science and my foundations, my actions needed to follow what my mind now understood. There wasn't a choice to be made; by knowing what I did, the decision had already been made for me; I had to be different.

One immediate change in my classroom was how I viewed students and how I calculated grades. Where I once looked solely at a percentage to determine a student's letter grade, I now understood grades as a whole were subjective; I could not simply look at a number and associate that number with a student's learning. There was much more to a grade than quantitative data existing in absolute certainty inside my grade book. I looked beyond the percent and saw the student as a work-in-progress, or more appropriately a work-in-*process*. I felt the freedom to look beyond a student's paper to figure a grade; things like a student's work ethic, attitude, growth, and home life, among other things, now entered into the evaluation of my students.

I also started to see students as adolescents and not just receptacles for science knowledge. I now had a reason and a desire to view them as people who have stories to tell and who have value not just for their grade. There was reason to see worth in students who weren't learning science. Even though I never deliberately shunned any of my students who were making bad grades, they did seem to get under my skin—deep under my skin. I thought they were lazy and I didn't want to waste my time trying to connect with them. In a sense, I thought my greatest impact would be on those who wanted to put forth the effort to learn science. I only saw value in students who would do the work assigned. If they didn't do the work, I didn't necessarily

ignore them, but I didn't give them nearly the attention I gave those students doing well in science. With a new focus on relationships instead of things, I was compelled to develop meaningful relationships with all my students, not just those making the grade.

One example stands out in my mind which epitomizes this shift in values. I had one particular student who did little if any work in my class (or any others for that matter). He would come to class many times without paper, pencil, book or any other 'learning tool.' He was somewhat intelligent, but he seemed to be lazy and a waste of my time. I didn't go out of my way to help him or to discuss anything with him except for the occasional interrogation about where his homework or supplies were. The kid really annoyed me. After coming to the realization that I should be placing more value on the relationship instead of the grade, I started talking to the student about non-academic things. We had several conversations about his enjoyment of sports and video games. I tried to see him not as a lazy, invaluable student of my classroom, but as a person who had stories to tell and experiences to share. I stopped barraging him with questions about his homework and his lazy disposition, but instead focused on how I could better understand the kid.

To my utter amazement, the relationship blossomed and he began to give me a glimpse of what his home life was like. He didn't give many details, but from what I could gather, he spent a majority of his time alone at home, having to fend for himself, usually in front of the television without much accountability. He lived with his grandmother who worked hard hours trying to provide financially for both of

them. His life read like the stories my classmates in the master's cohort shared. I couldn't imagine a childhood like the one I was trying to understand.

After a couple of weeks of trying to understand the kid and not just the bad grade, he began to sporadically turn in assignments. He also improved his grade in science. My goal was never to 'use' the relationship to make his grade improve, but his grade did improve because of the relationship. He never became an academic all-star, but his noticeable improvement in my class supported my newfound belief in the value of relationships. I was wary, however, of 'using' relationships to try to improve a grade. I wanted to keep my understanding of relationships as pure as possible—no strings attached. Even if the student had not improved his grade, I felt we both gained from sharing our experiences. I believed I helped him enjoy at least some part of his seventh grade year, even though it may have been only a small part. But I understood the importance of the small things because of the Butterfly Effect. I was confident that because of the relationship, we would both be impacted; I only hoped it would be positively.

In short, by understanding the new science, I was able to grasp the importance of getting to know students not solely for the talents and grades they could bring to my classroom, but for their value as humans, living in the same time and space as I was living. My teaching values changed from a focus on grades, to a focus on students; relationships were more important than numbers. As Wheatley (1999) summarizes, "We live in a world where relationships are primary. Nothing happens in the quantum world without something else encountering something else. Nothing exists independent of its relationships" (p. 69). During my encounter with the student

I finally got it; I understood how the story behind the grade was more important than the grade on the paper. In fact, by building a relationship with student, I was more willing to let things slide and to evaluate him differently than I had done in the past. I chose to see his whole story and not just the story he turned in (or didn't turn in) on a sheet of paper.

But the classroom door didn't confine my change in values. I also realized my other relationships in life, although not evaluated by a grade, were also lacking an understanding about the importance of relationships. The team meetings I had been attending with Mrs. Robb and Ms. Seilig had always been, for me at least, about getting to the business of the meeting; I didn't much care about the fluff. I never enjoyed the time we spent discussing our weekends or other events occurring in our lives. I focused on getting to the point of the meeting and then getting back to my own classroom; I wanted the meetings to be more efficient and productive.

However, the same mental shift I encountered with my failing student also influenced my attitude about those team meetings. I had a limited view of the purpose of the team meetings just like I had a limited view of the purpose of a teacher. Teaching, as I now understood, was not just about making students learn a subject, but it was about developing meaningful relationships with students. Team meetings, I realized, were not just about getting items checked off a to-do list, but about living our lives together as teachers, about sharing our stories as people. I was never able to see beyond the commonly expected outcome for team meetings (or teaching for that matter), which I thought was solely about productivity and efficiency. I now understood the importance of relating to my colleagues on a

personal level and sharing our life stories with each other. What caused me to be so frustrated in past meetings, I now saw as a vital part of team meetings.

It even translated to my personal life as I began to see value in others not just for what they could do for me, but for the value of the friendship and relationship, nothing else was required. No relationship was untouched by this new understanding of how connected we, as people, should be. Ms. Seilig and Mrs. Robb got it, however. They understood the importance of relationships. They valued my stories as well as each others; they realized relationships last and are vitally important to life. Although they didn't understand the science behind their actions, I felt they had a better grasp of relationships than I did. For them, the *process* was just as important as the outcome (if not more important).

I also began to view the learning process with more openness. Previously I was intent on assessing learning by evaluating the end-product and then placing a grade on it. Now, I focused on the processes students used to come to an understanding of their world. I started to see why student experiences are so vitally important. As Wheatley explains, "No one, not scientists nor leaders nor children, simply observes the world and takes in what it offers. We all construct the world through lenses of our own making and use these to filter and select. We each actively participate in creating our world" (p. 65).

Learning was not about me, the teacher, taking an arrow of information and shooting it at my students with the hopes of it piercing into their brains. Learning was a more involved process for me and my classroom. I had done hands-on labs previously because of the 'trendiness' of it, because it sounded like students would

learn more. Now I recognized that students needed valuable experiences in order to understand their world and make sense of it; I needed to focus more on letting students experience the learning process and experience that process in the context of community and not in isolation. I couldn't assume just because I said it, or because they read it in their books, that they knew it. Although I didn't completely understand constructivism, I kept hearing the words of Mr. Elliot echo in my ear. He talked about what it meant*to be constructivist* ; about "giving students meaningful experiences that allow them to make sense of their world" (personal communication, 2000-2003).

It also became apparent with my new understanding of science that I would expect my students to do something different with knowledge. As with quantum physics, it isn't about the parts as much as it is about the *relationships among* the parts. I questioned if my students should be memorizing 'parts' to the curriculum. I wondered how much meaning my students were getting out of memorizing the phases of mitosis or the parts to the body. I had learned all these things in my science classes, but I wasn't sure now what value it added to my life. I even asked my wife, who worked in the medical field as a registered nurse, if she could tell me the phases of mitosis, and she couldn't. I wondered why I required my students to memorize pieces of information they would probably never use. I wanted to get beyond having my students memorize parts, and instead have them see how the parts made sense together with the whole, how the science information related to other information.

As I put all these new ideas together in my mind, I couldn't help but think about the metaphor I once had for my classroom—the well-oiled machine. I thought

about using the weather metaphor, but I wasn't convinced; I needed one that I could latch on to. I decided I didn't like the machine metaphor because of what it inferred about my worldview. I didn't want to view my classroom from the mechanistic clockwork perspective. I wanted my metaphor to be more representative of my understanding about teaching and learning; I wanted it to reflect what I understood about science and the nature of the universe; I wanted it to accurately represent what I had learned about myself and my foundations; I wanted it to reflect the ideas of growth, process, relationships, development, and system. I could think of no better metaphor than to see my classroom as an ecosystem.

CHAPTER 13

UNDERSTANDING THE ECOSYSTEM

As I finished writing my final paper for the systems class, I was thoroughly convinced my classroom would function best as an ecosystem. I loved the idea in part because of the science behind it. I had a desire ever since reading Lewis Thomas to apply more science principles to my classroom. With the ecosystem metaphor, I finally had an overarching theme to guide my thoughts about education, teaching, and learning. I even tried exposing my students to some of the ideas that changed my view of the world. One of the things I tried with them was an investigation into how they used their sense of sight to understand their world.

In one of the meetings with the seventh grade science teachers, we were discussing how we would introduce and teach the human body, specifically the nervous system. I suggested we do some introductory demonstrations on visual illusions to get the students thinking about how trustworthy their senses and observations were. At first I wasn't trying to make a connection to any of the new science ideas I had learned, but as I searched for illusions, the connection became obvious.

Looking through a book on illusions by Block and Yuker (1992), the second chapter contained several illusions on ambiguous figures—one figure that has at least two different images within it. The interesting thing about these ambiguous figures is what you see depends on what you *want* to see. In the following example (see figure 1), the figure may appear initially to be a vase. Or it may be perceived as two faces looking eye to eye.

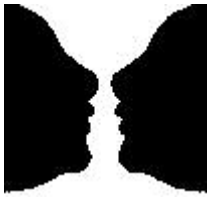

Figure 1.

Once you are able to see both, however, your mind seems to be able to shift from seeing one to seeing the other. If you want to see the vase, your mind switches to seeing it; if you want to see the two faces, you can seemingly force your eyes to see the faces. But, interestingly, you cannot see both at the same time. As the authors describe, "When you have made meaning out of the different forms, you will find that both illustrations are equally good, and that neither dominates the other…. On the other hand, even when you know that two pictures are there, you cannot see them both at the same time" (p. 15).

As I looked at the different ambiguous figures, I was surprised I could force myself to see the different images by mentally focusing on one of the images. As I flipped through the chapter containing the figures, I thought about the electron experiments about which I had recently read—about how the observer/scientist had influenced the behavior of the electron. What I was doing in my mind with the figures was the same thing! What I *wanted* to see was influencing what I *was* seeing. My perspective was directly affected by what I had a desire to see. I realized these images were great examples of how we cannot be uninvolved, objective observers. I immediately went to the copy machine and made overheads of several of the images so I could show them to my students. I wanted to discuss how our observations are shaped by what we want to see, and by what we have experienced in the past.

I talked to the other science teachers, including Mrs. Clark, about how I would be using the illusions. Although they seemed somewhat interested in the electron experiment and how it could apply to the ambiguous figures, none of them had the same strong desire to talk to their classes about the ideas that I did. I felt *I* had made my own discovery about the connections between the new science and visual illusions; I wanted to guide others towards the same knowledge, but others weren't fascinated by it as I was. Despite the other teachers' apparent lack of interest, I decided to show the images to my students anyway.

As I placed the vase image (or two faces image—whatever you prefer to see) on my overhead projector, I asked my students what they saw. Immediately, they gave the two answers I expected—some said it was a vase (or some variety of vase, such as candle holder or flower pot) while others said it was two faces. I asked them what the *real* image was, a vase or two faces.

One particularly bold student responded, "It is a vase. That is what I first saw, so that it what it has to be. I didn't see the two faces until other people started saying it."

Another student who was equally as bold responded, "But I saw the faces first. That means it is really two faces looking at each other. That is what the picture is trying to show."

I asked the rest of the class what they thought about the comments made by the two students. One student, who wasn't quite as courageous, explained, "Maybe it can be both. I can't see both things at the same time, but I can see both at different times if I try. Is it meant to *really be both*?"

I asked the class what they thought. Some thought it was meant to be a vase, others two faces, while still others thought it was meant to be both. The class as a whole was split on the *real* image. As the class conversation progressed, one student raised her hand and asked a question that shocked even me.

"Mr. Vincent, isn't that overhead just ink on a transparency? Are those really faces and a vase? Maybe it is supposed to be just ink on a page."

At first, the class seemed to dismiss her idea, but I pushed the class (and myself) to think about what she had just said. I probed my students, "How do we know what the person who created this picture was trying to make? Can we know what the figure was *really* meant to be?"

Now the conversion was getting deep. Even with a group of seventh-graders, my own ideas were being stretched beyond where they had been before. I could see how the ambiguous figure was simply ink on a transparency like the student said, but I had never thought of it that way. Her idea was taking the whole 'objective observer' idea much further than I anticipated. Partly because I was in unfamiliar territory with this new mindset, I decided to share the story of the electron and discuss with the class the whole notion of objectivity in observation and in life.

As I described the experiments done on electrons and explained objectivity, I didn't get the sense my students were making the connection to the ambiguous figures. The whole class discussion tapered off; I wasn't getting the same depth of conversation I did when we were talking about the overhead. Although a few followed where I was going, most appeared confused and content with simply talking about the vase/two faces. After the class ended, I sensed I may have pushed them too

hard and maybe even introduced some terms they had never used before (terms such as objectivity). That combination left a majority out of the portion of the conversation I thought was most important and most interesting—the science (and maybe even the philosophy) behind the ambiguous figures discussion. Although the class discussion could have ended much better than it did, I was reassured that at least some of my students left my class challenged by the ideas.

At the same time we science teachers were discussing the nervous system in our classrooms, the school district was pushing a type of instruction called differentiated instruction. I, as well as several of the other seventh grade science teachers, decided we would participate in the training being offered by the district.

Differentiated instruction revolves around the notion that students come to our classes with different ways of understanding their world (Tomlinson, 1999). Some may prefer to do projects and write in groups, while others may prefer to work independently. As such, teachers should allow students to demonstrate an understanding of the content by letting the student use the method or methods that best suites their learning needs; teachers should give students a choice and a voice in their education. As Tomlinson explains:

> In differentiated classrooms, teachers begin where students are, not the front of a curriculum guide. They accept and build upon the premise that learners differ in important ways. Thus, they also accept and act on the premise that teachers must be ready to engage students in instruction through different learning modalities, by appealing to differing interests, and by using varied rates of instruction along with varied degrees of complexity. (p. 2)

In essence the teacher has one set of objectives (the depth of which will be wide-ranging in many instances) with several different assignment options for students to show they understand those objectives.

Sitting in the training, I thought about my classroom metaphor—an ecosystem—and how differentiated instruction fit into that model. From what I understood about ecosystems, the more variety and diversity in an environment, the 'healthier' the ecosystem would be (see Nebel & Wright, 2000). If an ecosystem were composed of organisms that were too similar, one single parasite or pathogen could destroy the entire system; the living things of the system would not have enough differences to be able to resist infection. Basically, the invading organism would be exposed to a buffet of life—all of which would be available as a food source. However, if an ecosystem were composed of a wide variety of living things, the buffet of life would not all be available as food; the differences among the organisms would allow some to survive and thrive, while others would be eaten. Overall, however, the health and longevity of the system would be preserved because of the subtle, and even the drastic, differences among the living things. If there is a greater diversity of life, the ecosystem has a greater chance of maintaining itself over long periods of time. These ideas fit perfectly with my understanding of differentiated instruction.

To begin with, differentiation seeks to understand the variety of ways that students learn and use those differences to help students in the classroom. If a teacher sees value in these differences (like in an ecosystem) then the students will be more involved and engaged in the classroom and in learning. Instead of trying to make all

the students in the classroom the same, differentiation encourages variety and diversity and uses those differences to make a classroom more 'healthy.' In her book on differentiated instruction, Tomlinson (1999) even describes these "learning environments" as being part of a "healthy classroom" (pp. 25-35). She also describes the importance of understanding and responding to student differences. "In differentiated classrooms, teachers provide specific ways for each individual to learn as deeply as possible and as quickly as possible, without assuming one student's road map for learning is identical to anyone else's" (p. 2). If I wanted to have my classroom function most like an ecosystem, then differentiated instruction would be vital for the health of learning. The other science teachers and I decided we would do what we could to appreciate and encourage student diversity, even though it would require additional work on our part to create and evaluate the options given to the students.

The science department also discussed how we might use groups in our differentiated instructional strategies. We all agreed that some students preferred to work alone, and many of those students do very well with it. Other students, however, preferred to work with people, and for the most part, should be able to handle the responsibilities that come with working within a group. As we discussed the importance of allowing students to work in the environment they prefer, my ecosystem metaphor was strengthened. Many living things, like grizzly bears, live life as solitary creatures, while others animals, such as ants and other insects, have complex social structures and may die if in isolation. As Thomas (1975) explains, "Bees and ants have no option when isolated, except to die. There is really no such

creature as a single individual; he has no more life of his own than a cast-off cell marooned from the surface of your skin" (p. 63). Although humans appear to be social by nature, the science teachers and I all agreed that some of our students, indeed, did work best by themselves. We ended up creating several units using the ideas of differentiated instruction, and although it took additional work on our part, we all were confident we were doing what was best for our students. I was doing some of the best science teaching of my short career.

Finishing up the final few weeks of the year teaching my seventh-graders, I was relieved to have a metaphor to guide my thoughts on my classroom structure and on learning. Although I only had a few more scientific ideas I could apply to teaching (like my attitude about mistakes, differentiated instruction, group/individual work, and the value I placed on relationships over numbers/grades), I was challenged to find more. My thoughts about education had changed dramatically since my first day teaching sixth grade science, but I wasn't content to settle for what I had learned in the past few months. I thought about the ways in which my classroom functioned more like a machine instead of an ecosystem. The things I had become so accustomed to, like the emphasis on procedures and classroom management (Wong & Wong, 1998) seemed to contradict what I knew about ecosystems. I couldn't think of how ecosystems fit in with classroom procedures and behavioral control. I had more to learn; I wasn't ready to settle for just having a few science concepts applied to my room.

CHAPTER 14

DOUBTING

During the summer of 2001, the master's coursework was winding down and the cohorts looked forward to completing the intense fifteen-month program. We anticipated having our weekends free and having the liberty to read books for leisure, but there was one class to complete—a class on global education. At first glance, I wasn't sure if this class would offer anything I would particularly enjoy; the syllabus alone was thirteen pages in length and there wasn't anything in the syllabus related to my desire to improve my ecosystem metaphor. Looking over the assignments due the first day of class, however, I noticed that we were to watch a video called *Mindwalk* (Lintschinger & Cohen, 1990). Not ever being assigned a video to watch for a class, I decided to watch the video with some of the other cohorts; it was though we were back in our undergraduate days, watching videos in dorm rooms.

As the movie began to play, the opening credits showed the movie was based on the ideas of Fritjof Capra. It immediately had my attention; Capra was the author of two of the books (1996, 1982) I had read and that challenged me in the systems class earlier that spring. The global education professor's thirteen-page syllabus immediately became a non-issue. It encouraged me to think that this class might have something to help me understand my ecosystem metaphor.

During the course of the video, the same words that stood out in the systems class—systems, process, and relationships—stood out again. One of the main characters, Sonia, who happens to be a physicist, talks at great length about the traditional understanding of the atom and subatomic particles (proton, neutron,

electron) and how that understanding has shaped our view of the world. Just as Capra and Wheatley (1999) described, Sonia explains the metaphor of the mechanistic, machine Universe and even describes how Descartes and Newton were given credit for its use. She claims on several different occasions that she doesn't think Descartes' or Newton's ideas are bad or evil, but the application of those ideas has maybe done more harm than good. She feels the metaphor of the machine has been substituted for reality instead of being used as one possible explanation of physical phenomena. She contrasts the mechanistic view of reality with her understanding of quantum physics and the new science. The metaphors she uses are more about relationships and systems, the same metaphors I had learned about in the systems' class. Throughout the entire movie, I was intrigued by how much of it I understood. I finally understood and could apply the new science to my perception of the world.

However, as the movie played, I wasn't focused so much on systems, process, and relationships as much as I wanted to understand specific aspects of the new science. I wanted to find other ideas that would help me understand my classroom ecosystem. Towards the end of the movie, I got my wish. I recognized a couple of ideas that kept grabbing my attention—efficiency and productivity. These words would eventually have me doubting my career choice as a teacher.

In one particular scene, the three main characters venture outside and look at the trees and landscape that surrounds the castle they have been exploring. One begins talking about the whole notion of mechanistic thinking in the modern world. Sonia points to the trees and asks about the seeds it produces. She wonders out loud about how many of these seeds would be, in most people's mind, productive. I

immediately thought about the ones that would produce new trees; the ones that fulfill the 'purpose' of being a seed. However, of the hundreds of seeds the tree produced each year, only one or two, if any at all, actually produces a new tree. To me, it seemed terribly inefficient and unproductive. If I imagined the tree over the course of its lifespan, the tree would appear extremely inefficient at making offspring; there were too many seeds that would go to waste.

As the three characters discussed the ideas of productivity, efficiency and ecosystems, it became clear to me that I didn't truly understand ecosystems. In looking at the purpose of a seed, I was boxed-in about my understanding of what the functions of seeds were. To me, a seed only served one function for a tree—to produce more trees. However, I never thought about what else used those seeds, and how those other organisms influenced or affected the tree. I didn't recognize that the squirrels could use those seeds as a food source for an entire year, and in turn, the squirrel could attract other animals either for their own food source, or for what the squirrel left behind. My limited perspective wasn't allowing me to see the entire system and how the system worked within a context of all living and non-living things. I was *still* focused on the parts as separate entities; I hadn't truly understood what it meant to see things not as separate parts, but as being in relationship to other things.

This insight made me doubt my entire understanding of classrooms and teaching. If I was going to use the ecosystem metaphor for my classroom, which I thought was a perfect fit for me, I would have to be more knowledgeable about ecosystems. What was so frustrating, however, was *I thought I was knowledgeable*; I

thought I understood ecosystems and how they worked. I had faith in my scientific understanding, but that faith was quickly eroded as I pondered the purpose of a seed.

I thought about my classroom and how I used the ideas of efficiency and productivity. I started to place more value on the process of learning, the value of relationships, and the systems view of my class, but I began to doubt the worth of what I was doing. My ecosystem metaphor, the metaphor I had so eagerly embraced, now became the proverbial thorn in my side. I realized I still valued efficiency and productivity in my classroom. Even when I was letting my students be inefficient, by not talking about science for example, I would have feelings of guilt. Was I looking at my students as I looked at the seed? Was my view of the purposes of teaching too narrow and traditional? I still thought the metaphor would work, but I didn't know how to make it work. I even thought I may have learned too much about ecosystems. Before questioning the purpose of a seed, I had a strong desire to pursue teaching, and to pursue it aggressively. As I started to doubt my metaphor, I began to question my place in the classroom.

Throughout the global education class, I was somewhat reserved; I didn't have the urge to confront anyone who dared to be sarcastic or demeaning to the new science I had learned about a few months earlier. I wasn't eager to write papers about how to teach or about education in general. In short, I felt I wasn't meant to be in the teaching profession. But as a final project for the master's program we were all asked to create a portfolio, which would include a short educational autobiography.

As I wrote my autobiography, I couldn't help but wonder what might have been in my life. What if I had never learned to recognize the mechanistic worldview?

What if I could (and wanted to) still envision my classroom as a well-oiled machine? What if I would have pursued medical school instead of education? There were so many questions that caused me to doubt my choice of professions, but I couldn't help but focus on the last question. Partly because of my love for science and partly because of my frustration with how I *couldn't* do teaching like I wanted, I began to give serious consideration to applying to medical school. Because of what I learned about my foundations and about education, I continually had the feeling that I was screwing up in my classroom; I couldn't do things the way I wanted to. The metaphor that enchanted me was the metaphor that kept me from whole-heartedly embracing teaching as a life-long profession. The degree I was getting, a master's in the *foundations* of education, was the degree exposing too much of my foundation; it was the degree that was driving me to do something else. I couldn't teach the way I thought would be best; I wasn't creative enough, nor did I think I would ever get it right.

Of all those thoughts that kept me from wanting to continue in education, one idea kept me coming back to teaching as my life's calling—the Butterfly Effect. I knew I had made a significant impact on several students in my two short years in the classroom, and those were the ones whose parents chose to tell me about it. I did lots of small things that could have huge impacts in the lives of my students—things like having playful conversations with the kid who never did his homework or rounding an eighty-seven percent up to an 'A'. Of all the things I couldn't get right, I knew I had done some things the right way; the very thought of those small things kept me thinking about my future as a teacher and as a professional educator. I decided that

teaching was what I was meant to do. I understood some of my foundations (at times I felt I understood too much), and I wanted to challenge myself to stay with the process of becoming a teacher. I didn't expect I would ever get it all correct, but I finally decided to stay in the classroom, ecosystem metaphor in hand.

CHAPTER 15

ANOTHER CHALLENGE

Once the decision was made to continue teaching, I was gung-ho about it. The master's program came to a conclusion at the same time a new school year was commencing. I thoroughly anticipated the chance to work with my colleagues in the science department as well as my colleagues on my academic team. There was excitement because we all felt (both the science department and the academic team) that we ended the year on a high, and that the high would propel us into a great start of the new school year. I was glad I made the decision to stay in teaching.

As I worked with these colleagues, I recognized the importance and value these people had in my life. I enjoyed listening to their stories and being involved in their lives; the relationships I had taken for granted at one time had become more than just professional relationships; they became personal. As our friendships continued to grow and blossom there were talks about our school district offering a doctoral program similar to the master's program I had just completed. Although it wouldn't start until the following summer, I had a strong interest in understanding more about education. I also had a somewhat unrealistic expectation that I would be changed in a doctoral program like I was changed in the master's program. Although my metamorphosis was difficult to endure, it had bettered me; it had caused me to be an improved person in all areas of my life. I wanted a similar experience and I wanted to refine the ecosystem metaphor I had created during the master's program. There was no other place I could envision that would allow me to refine my ideas and challenge

me than what would be offered in the doctoral program. I signed up and started classes the following summer.

As we received syllabi for the doctoral classes, I realized my perspective on graduate work had changed dramatically compared to when I started the master's program. As I looked through each syllabus and thought about each class this time, I wasn't intimidated by what I read or afraid of what the professors might require us to do. Instead, as I read through the syllabi, I looked for opportunities that might strengthen my ecosystem metaphor and improve my understanding of education. In the master's program I wasn't prepared to learn from the beginning. I didn't think there was much value in education courses, and that mentality skewed my perception of what I *could* learn. I thought there was more value in learning science instead of learning about learning. Now I realized there were many things in education I was ignorant about, and I needed to rid myself of at least some of that ignorance.

In addition to looking at each syllabus with the hopes of being able to learn more about education, I was also hoping that for each class there would be an opportunity to do an independent project or paper. My ecosystem metaphor was still challenging my thoughts about teaching and learning, and I wanted to learn more about how to apply scientific principles to my classroom. As I would soon learn, each of the professors from the program would encourage us to start focusing on a particular topic of interest so we would be well prepared to complete a dissertation after the coursework was over. Of course, as the professors asked us about our focus, I described my desire to create my own classroom environment model that used ecosystems as the metaphor.

Another difference in perspective was what I valued as knowledge. In the master's program, I wasn't interested in qualitative research classes or qualitative research studies simply because I didn't feel they were 'sciencey' enough. The supposed insights and knowledge gained from the soft sciences, like sociology, psychology, or history, held little or no weight in my mind. Now, after learning about the new science and my foundations, I was deeply interested in these soft sciences and how they could help me improve my metaphor. When starting the doctoral program, I embraced qualitative studies and even those classes that focused on qualitative research methods, not only for the value I now saw in them, but also because I might have to use qualitative research methods in my dissertation.

Just like in the master's program, most of the professors in the doctoral program took time at the beginning of each class for introductions. Whereas in the master's program I didn't particularly enjoy this part of class, now I saw value in what I heard others say. There was so much to be gained by listening to others talk about themselves. I could have never imagined myself enjoying this part of class during my master's work, but now during the doctoral cohort, I was drawn to understanding the lives of the students in the class as well as the professors.

As the classes came and went, I was intent on doing as much as possible with my ecosystem metaphor. If there was a chance to read an outside book or article or even write a paper over a broad topic, it would inevitably be focused on ecosystems. Although I wasn't able to improve much on the metaphor during the first few semesters, I was increasing my understanding of education as a whole, which in turn improved the way I interacted with students, colleagues, and administrators.

When the spring semester rolled around, I was working both as a teacher and as a student on my classroom metaphor. I didn't feel I had any great advances or improvements over what I was doing compared to the end of the master's program, but I was enjoying being a teacher to my students. I enjoyed not just the science I was teaching, but also the students I was teaching. I had read a book by Caine and Caine (1997) about two school systems that tried to implement the ideas of the new science in the classroom, both the successes and the struggles they encountered, and I was encouraged by what they wrote:

> We do not claim to have solved the problem. We do claim to have found a path…. Our experience is that educators who walk the path diligently undergo a major personal and perceptual transformation…. And these are the people who have the qualities that make it possible to educate children in a way that is appropriate for survival and success in the next century. (p. 100)

Caine and Caine, in describing the path others had taken to transform their teaching, were describing some of what I experienced during my perceptual transformation. I felt I was 'walking the path diligently' in trying to understand teaching and learning

I was also learning more about the roots of efficiency and productivity in education (Callahan, 1962; Taylor, 1911) and expanding my understanding of the use and application of metaphors (Collins & Green, 1990; Lackoff & Johnson, 1980; Weade & Ernst, 1990). My views of education and why it was the way it was were being broadened (Gutek, 2001; Spring, 2001) and I was more fluid in my understanding of what it meant for students to be productive and efficient (Kaestle,

1973). In fact, I was constantly questioning the purpose of schooling in my classroom when my students weren't doing the assignments I expected. While trying to build relationships with my students, I was also trying to work with my colleagues to make the schooling experience a better and more meaningful one for students and teachers alike.

While taking pleasure in working with students and colleagues, the grind of having many of my weekends spent in a classroom with twenty other graduate students was beginning to takes it toll. The classes and the process were enjoyable, but taken on top of being a teacher was becoming extremely difficult. I didn't feel that my ecosystem metaphor was coming along as I expected, and there wasn't the epiphany I had hoped for. I wondered if I was getting burnt out on being a student.

At what seemed like an apropos time for my attitude about being in class, we began a doctoral class during that spring semester on educational futurism. The professor of this class was the same professor who had taught the systems class during the master's program. Obviously, I was excited to start this class and hopefully, be as challenged as I was before. By the time I had finished the class, however, I found myself questioning my desire to do a dissertation over a classroom ecosystem model.

The questioning started when I read through the first of two assigned books for the class. The first few chapters of the book, *Curriculum dynamics* (Fleener, 2002), summarized what I understood my educational foundations to be—that of modernistic and mechanistic thinking grounded in a strong belief in the power of scientific understanding. As Fleener summarizes,

> The impact of the Newtonian science and the underlying logic of domination of modernism are still felt in our schools today. Scientific rationality; beliefs (and confusions) about the validity of measurement and the objectivity of reality, a curriculum that emphasizes mathematics and science over other subject matter; and the perceived crisis that the 'American way' is in jeopardy if our children cannot 'successfully compete' in a global marketplace, are all embedded in the modernist mind-set. (p. 71)

Reading through those opening chapters it captured, for the most part, what I had learned about my foundations. If my dissertation was to be about a classroom ecosystem metaphor, then I would have to explain the historical foundations that led schooling and education towards the machine metaphor. Fleener's book (as well as Doll's book [1993], which I reexamined while in the futurism class) laid the foundation nicely; I didn't think there was much else that could be explained. Adding to my doubts about creating a dissertation on an ecosystem model was the extent and breadth of Fleener's and Doll's explanations. Their explanations were much more in depth than I could create for my own dissertation that argued against the machine or clockwork metaphor. In short, I was intimidated by what I didn't know and by how much I would have to do in order to write an adequate dissertation on the topic.

In addition to the historical foundations of the mechanistic understanding of the world and systems was the vision Fleener cast for education. The titles of several of the chapters included "The Logic of Relationships," "The Logic of Systems," "The Logic of Meaning," and "Schools as Learning Organizations." These areas were similar to what I envisioned in a classroom or educational system that used the

ecosystem metaphor. Fleener's chapters provided, as a whole, "…the language, metaphors, and ways of talking about schooling to overcome our modernist tendencies and [provided] a way of seeing as and thinking about the world imbued with meaning and purpose. Like a hologram, together these postmodern logics provide an image of how schools might be" (p. 158). Fleener's ideas, although in much more detail than I could have ever imagined for my dissertation, were what needed to be said about my ecosystem metaphor. As such, the doubt about actually doing a dissertation on the metaphor began to settle in.

The other book required for the futurism class was *Technopoly* by Neil Postman (1992). Reading the first few chapters, nothing really life-changing or mind-altering came to me. It was an enjoyable read, but nothing really stood out. Postman talked about man and his use of tools, which was apt for where I had been as a teacher. He explains,

> …to a man with a hammer, everything looks like a nail. Without being too literal, we may extend the truism: To a man with a pencil, everything looks like a list. To a man with a camera, everything looks like an image. To a man with a computer, everything looks like data. And to a man with a grade sheet, everything looks like a number. (p. 14)

Reading that passage, I couldn't help but think about how appropriate and fitting it was in summarizing my views on grades before understanding my foundations. My grade book was the tool that allowed me to view each of my students as quantitative data and reinforce my views of learning, teaching, and the value of numbers in understanding the world. The fixation I once had for certainty by

way of quantitative data was summed up in what Postman described. However, this passage wasn't what altered my viewpoints on my dissertation. It wasn't until I read two sentences on page fifty-eight that I decided not to write my dissertation over the ecosystem metaphor. Postman, when questioning the power of technology in today's society, states, "In the Middle Ages, people believed in the authority of their religion, no matter what. Today, we believe in the authority of our science, no matter what" (p. 58).

These two sentences, which could be missed or easily overlooked, stood out to me as I pondered the importance of having my room function most like an ecosystem. In reading and rereading the sentences, I realized I still valued, almost to a fault, the value of a scientific understanding of the world. I was trying to base an entire classroom model on a scientific understanding of living systems. I was doing the same thing I had done before understanding my foundations; the only difference being that this time, my science was 'newer' and more in line with what science now understood (or didn't understand) about the 'reality' of this world. I was viewing a different landscape, but with the same glasses. My mindset had not truly changed about the value of science. As Postman might explain, I believed in the authority of my science, "no matter what" (p. 58). If my dissertation were to be about making a classroom like an ecosystem, it would imply that I still held science in the highest regard over any other type of knowledge or understanding. However, I didn't want to give any inkling that science was my religion; I wanted to demonstrate I was viewing the world with a different set of glasses and not just looking at a different landscape. Fleener (2002) describes educational research and the doubts I was now encountering.

"As Heisenberg and Bohr discovered eighty years ago, what we choose to examine, and how we choose to measure it, will, in a very fundamental way, bring forth the reality we are looking for. We also must realize how our inquiries communicate and create value" (p. 191). By choosing to do a dissertation over scientific principles, I was choosing to place the highest value on science. As such, I came to the conclusion that I needed to abandon my desire to create a classroom model that used scientific concepts and instead, focus my energies on something else; the biggest problem, however, was I didn't have any idea about what else interested me. That would change during our next doctoral class, which happened to include a strong emphasis on our dissertation topic.

As the class began, the professor went around the room asking each of us what we were planning on doing in our dissertation. I heard several people give detailed descriptions, others offered vague responses, and still others who were honest enough to say they didn't know what they wanted to do. The professor was patient and encouraging to each of them, but she hadn't listened to me yet. As my turn came, I was dumbfounded by what I should say.

"So, Dan, what are you thinking?" she asked.

I thought I would mention what I had planned on doing to see if there was anything there. "I am thinking about doing something over a classroom ecosystem model, but I am not in love with the idea. I like the metaphor and how it could apply, but I don't necessarily want to write a dissertation over it. I want to do something over the new science and its application to education, but nothing has jumped out and

grabbed me. I thought it was the ecosystem model at one time, but now I don't know."

The professor responded, "You know, Dan, there is sort of a new thing in dissertations now. People are actually writing their autobiographies for the dissertation. I knew you when you started the master's program, and I think you have a story to tell. The dissertation would be a complete one-eighty from what you 'sciencey' folks are used to, but I think it would be good."

I couldn't believe she was suggesting I write serious research over my five years of teaching. I questioned her about the legitimacy of an autobiography. "How trustworthy would an autobiography be? How could anyone see themselves as serious research subjects? There is no hard data to collect or procedure for writing an autobiography. And besides, I am only twenty-five years old; I haven't lived long enough to write a story about it."

She immediately responded, as if she had thought about my particular concerns for days, "But Dan, each of us is hundreds of years old."

At first, her response sounded ridiculous to be honest. I didn't understand what she meant by the 'hundreds of years old' statement. How is *that* supposed to make me feel more comfortable about writing a dissertation over a measly five years of my life? I was only a quarter of century old; she seemed closer to the century mark. She may have felt hundreds of years old, but I wasn't sure where she was going with her statement. As we talked I began to understand what she was trying to convey.

The professor explained that all institutions and mindsets—education, political, cultural, philosophical, to mention a few—are built upon the understanding and advancements of the people before us. We as a society and as people haven't formed our thoughts out of nothing; they are the result, albeit modified and changed to suite differing needs, of previous generations' ideas and views about the world. Each of us is indeed hundreds of years old.

I thought about our conversation within the context of my own educational journey thus far and immediately saw the application. When I began teaching, I didn't understand my foundations; I didn't understand my 'hundreds of years' of history. Although I was confident in what I knew about myself as a twenty-one year old entry-year teacher, in actuality, I was clueless. If I were to write an autobiography, it would be about my educational journey to understand my foundations, my history, and my trying to make sense of those experiences.

In an effort to better understand educational autobiographies and how they could be used for a dissertation, the professor encouraged me to read some of the autobiographies already written for dissertations. As I searched for the dissertations, I wasn't able to locate many written by science teachers. In fact, I only found one, *The making of a bilingual science educator: An autobiographical study*, by Chacon (2002). Although he wrote an autobiography of his science teaching, it was more focused on the bilingual aspect of the author's life and not about the science. There was a story I could tell that had yet to be written.

But there was still the question of the rigors of doing an autobiography and also about what I, or anyone else for that matter, could learn by me writing an

autobiography. I didn't want to justify my doctoral degree every time someone asked my about my dissertation topic. In a way, I was also afraid if I wrote an autobiography, everyone in the academic field who knew about dissertations and research would laugh at my degree. I wanted to make sure my degree would not mean less if I wrote the story of my teaching life. I had a desire to teach in colleges and universities eventually, and I didn't want to jeopardize my chances of getting a job by doing something that wouldn't be considered 'academic' enough. In short, I still questioned the legitimacy of an autobiography as serious research.

As the spring semester was winding down, I contemplated writing my autobiography, possibly being a college professor, and simply making it out of the doctoral program. But I was still focused on being the best teacher I could, knowing what I did about my foundations and the new science. And, to be honest, my teaching, along with the other science teachers and the teachers on my team, were continuing to improve. My colleagues and I were working so closely together that we felt like we were doing some great things for our kids. We were focused on the process of learning, building relationships with our students, and on building meaningful relationships with each other. I was very comfortable with my position within the school system and how I thought things were continuing to improve in my classroom. But those thoughts would be dashed as I was informed late in the spring of a change in teaching assignment that would have me questioning the competence of the school system in which I worked.

CHAPTER 16

MOVING RIGHT ALONG

One afternoon in late spring as I was preparing to begin class with my seventh-graders, I got a knock on my classroom door. As I opened the door, I saw one of the school secretaries. "Mr. Vincent," she said, "Mr. Fulton needs to see you in his office. I'll watch your students while you are gone. It shouldn't take more than ten minutes."

"What did I do?" I asked, wracking my brain for things I could have done wrong to warrant a trip to see the principal.

"Nothing," she responded. "He just needs to see you for a few minutes. You won't be gone long; I'll be sure to take good care of your kids."

I couldn't imagine what Mr. Fulton wanted. He was the same person who I met while working at the home improvement store straight out of college, and the same person who got me the interview with the district. He had just recently taken on the responsibility of being the principal of the middle school in addition to the freshman center because of district financial problems. In fact, the financial problems were not unique to our school but were common across the state and nation, and they were expected to continue into the following school year. The former principal of our school was replaced by Mr. Fulton in an effort to save money, and there were even talks of having to get rid of teachers to help with the financial crunch.

As I made my way down to his office, I couldn't help but think about the current fiscal state of the district and how that might relate to my call to the office. Although it was a good minute walk from my room to his office, I didn't have long

enough to dwell on many of the possible things the meeting could have been about. As I entered his office, he was sitting behind his desk. He stood to welcome me. "Mr. Vincent," he said, "Please, have a seat."

I obliged without saying a word, but invited him to talk by raising my eyebrows and giving him a smile.

"I don't how else to begin," he said. "You are moving to the high school next year."

Inwardly, I immediately knew what he was saying, but I didn't want to believe it. "What do you mean?" I asked, wanting to hear something other than what I expected.

"As you know," he began, "the district is having some serious financial problems this year, and it is supposed to get even worse next year. We have to cut positions and shuffle teachers around because of the looming problems. Since you are certified to teach high school science we have decided to move you next year. You will be great."

In that moment, I realized that if I were to move schools, I would be disconnected from all the other teachers and students with whom I had formed strong relationships and be separated from a curriculum I helped to improve. I liked the teaching situation I was currently in, and as such, I probed Mr. Fulton for answers. "Do I have a choice? I really like teaching here at the middle school. I know my colleagues so well and we work great together. Is there anyone else who could do it and would be willing?"

"Not really," he replied. "I have talked with the principal at the high school and we have looked at other options; this is the only one that works. You will be teaching at the high school next year."

There didn't seem to be any way around it; I wouldn't be a middle school teacher anymore. As I left his office, he shook my hand. "Thanks for understanding," he said. "You'll be great up there."

I couldn't muster up any sort of response. It was if I had been hit with a medicine ball square in the abdomen and had the breath knocked out of me. After all I had done for the school and for my students the administration was *making* me leave. Although he thanked me for understanding, to be quite honest, I didn't feel I understood. I didn't want to leave the middle school and the people I had grown close to. And even though Mr. Fulton had said there were no other options, I knew there had to be. Surely, I wasn't the only one who was qualified and able to teach high school science. I knew I wasn't willing; someone else had to be.

As the door closed behind me, I realized I had to go back to my classroom and face thirty adolescents who expected me to be the same old Mr. Vincent. I didn't want to go back. I was too torn up inside to want to teach anymore that afternoon. I needed some time to sit and sort out what had just happened. I decided I would take my time ambling back to my classroom; it must have taken a minute and a half and I was back at my door. I was more shocked now that I had a few seconds to think about it, but nothing was resolved in my mind. I decided that being with my students would be best, so I went back into my classroom, thanking the secretary for watching

my students. I finished up the day teaching, all the while thinking about what next year would be like.

When the teaching day ended I told my colleagues about the plans for next year; they, of course, were understanding and supportive. We talked about other possible options the district might have, but we came to the conclusion that this was the only one they had. I would be moving to teach at the high school, and once again, start fresh in a new setting. I had taught sixth-graders for one year, seventh-graders for three, and now I was moving to the high school to start the process all over again.

As I said my good-byes at the middle school, I was also preparing myself for what was sure to be a different experience at the high school. The same feelings I had starting both sixth grade teaching and seventh grade teaching filled my thoughts. I was unsure about how I would handle high school students. My confidence was shaky to say the least, and I fretted over how I would *teach* them and how they would *treat* me. They were so different than middle school students, and I didn't have anyone at the high school with whom to collaborate. I even tried talking to several of the high school teachers who would be teaching the same subjects, and it seemed there wasn't much, if any, collaboration that occurred at the high school. What I had been so accustomed to and what I knew was so valuable—meeting with other teachers to work out lessons and strategies to better our teaching (Caine & Caine, 1997; Schmoker, 1999)—wasn't going to happen at the high school. I had to face the reality of working, for the most part, on my own in the classroom even though I knew I would never be my best. From what I experienced during the past three years and

from what I understood about relationships in the new science, being connected was crucial, and I wasn't going to have that luxury.

Needless to say, that summer was spent doing all I could to get a handle on the high school curriculum I would be teaching. The problem was that I also had the doctoral program to worry about, which included trying to figure out if an autobiography was a worthy dissertation topic, something I was leaning more and more towards the more nothing else seemed appealing.

When I started teaching at the high school, I was surprised at how much I reverted back to teaching the way I had done my first year with the sixth-graders. I knew in my mind I should be doing more to give the students meaningful experiences, but frankly, I didn't have the time to plan anything meaningful for them to do. Much of my time was spent preparing notes for three different classes; the students spent much of their time reading a book, taking notes, and doing labs somewhat related to the content area being discussed. Granted, there were a couple of things here and there we did that I thought really forced them to think and allowed them to make connections to their own lives, but overall, I wasn't doing my best. I was able to do the photosynthesis activity again with my 'new' students (Brooks & Brooks, 1993), and once again, it went over great as the students were able to connect the process to their own lives, but there was very little else that I thought was good enough. Adding to my frustrations was no one else was willing or able to collaborate and talk about science teaching. My colleagues were all great people with a heart for teaching, but their perspectives were completely different than what I was accustomed to. The mentality at the high school was more isolationist and content-

driven. Instead of teaching in teams and working together on curriculum, as was done at the middle school, the high school was organized by departments and teachers planned for their classes alone (from what I could tell). I had a strong desire to work with other teachers, but I began to face the reality that I would be flying solo for as long as I was teaching high school science.

While coping with the reality of teaching in a high school, the doctoral students began a class that included the writings of John Dewey (1938; 1944; 1956). I had heard of Dewey from several of the other graduate classes, but I never understood why he was referred to so often in educational circles. In reading Dewey's *Experience and education* (1938) I found he was a strong advocate for giving students quality, meaningful experiences. Traditional education, according to Dewey, did offer students experiences, but they were often, as he describes, "mis-educative" because they have "the effect of arresting or distorting the growth of further experience" (p. 25). He continues:

> Traditional education offers a plethora of examples of experiences of the kinds just mentioned. It is a great mistake to suppose, even tacitly, that the traditional schoolroom was not a place in which pupils had experiences. Yet this is tacitly assumed when progressive education as a plan of learning by experience is placed in sharp opposition to the old. The proper line of attack is that the experiences which were had, by pupils and teachers alike, were largely of a wrong kind….the trouble is not the absence of experiences, but their defective and wrong character. (pp. 26-27)

What Dewey was arguing against was the exact thing I did as I began my teaching career, and the same thing I found myself doing with my high school students. I would try to give my students experiences, either through labs or activities or group work, but I did little to connect those isolated experiences to their world and their lives. I was giving my students mis-educative experiences. I did my best to help my students make connections between classroom experience and real-world experience, but I didn't feel I was doing the best job possible. Coming from the middle school where we teachers worked together to give students experiences they could apply to their daily lives, I felt my teaching was relapsing. As I continued to read Dewey, he offered his explanation for the difficultly:

> To discover what is really simple and to act upon the discovery is an exceedingly difficult task. After the artificial and complex is once institutionally established and ingrained in custom and routine, it is easier to walk in the paths that have been beaten than it is, after taking a new point of view, to work out what is practically involved in the new point of view…. The process is a slow and arduous one. It is a matter of growth, and there are many obstacles which tend to obstruct growth and to deflect it into wrong lines. (p. 30)

Here I found myself working, virtually in isolation, doing what my students expected from the educational institution. I worked hard to create meaningful and quality experiences in my class, but working alone exposed, once again, my lack of creativity in teaching and my foundational perspective of what learning was all about. I still was drawn, as Freire (1993) might describe, to the notion of banking in

education. "The teacher talks about reality as if it were motionless, static, compartmentalized, and predictable. Or else, he expounds on a topic completely alien to the existential experience of the students. His task is to 'fill' the students with the contents of his narration…" (p. 71). Freire continues:

> 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)

I knew it wasn't best for students to be in a classroom like I had created, but it was so ingrained in my thinking and so easy to do, that I didn't have any other choice. Despite my prior emphasis on relationships and the process of learning with my seventh grade students, I found myself trying to make educational deposits into my high school students' minds. As a teacher in a new environment, with a new curriculum and not enough time, it was much more manageable and efficient to view education using the banking metaphor. Julyan and Duckworth (1996) confirm the feelings my students and I were experiencing:

> One concern this type of research [constructivism] raises for some is that students can become frustrated by the considerable time and attention required, and that they prefer to gain their knowledge through transmission rather than construction. As one of the authors has written before (Julyan,

1989), science-as-vocabulary requires less effort on the part of both the teacher and the student, but also provides fewer rewards. (p. 68)

After reading through Dewey and discussing his ideas in the doctoral class, I felt so frustrated that my teaching wasn't what it had been previously. I wanted to do what I knew was best for my students, but the laborious task, both for me and my students, was too much of a battle. Despite the difficulty, I needed to do it not only for my own peace, but also for the benefit of my students and their learning.

As the school year progressed, I worked hard to make my classes more meaningful for students. I carved out more time in my schedule to focus on planning my classes, and in turn, my teaching improved. I still desired to work with other teachers to at least talk about learning and education, but no one at the high school—because of time, ability, or institutional constraints—could offer what I had experienced at the middle school. I did, however, feel nourished in my doctoral classes; it was my chance to talk about real educational issues with other educators. Even though we didn't plan out lessons or work on curriculum units, the cohort classes challenged me to think about learning and my role as a teacher in facilitating the *process* instead of providing the informational currency that was to be deposited into my student brain account.

Also in the doctoral courses, I started to get a vision for my dissertation, and, surprisingly it actually helped that I had moved to the high school and was being challenged to provide meaningful experiences to my current students. Reading through Dewey and understanding his views on experiences, more importantly, meaningful experiences, I realized an autobiography would be my chance to make

meaning out of the experiences I had in teaching and in the educational field. As Dewey (1938) explains, "There is, I think, no point in the philosophy of progressive education which is sounder than its emphasis upon the importance of the participation of the learner in the formation of the purposes which direct his activities in the learning process…" (p. 67). The dissertation was, in essence, a huge independent learning project. If I wanted to make the most of it, it was now logical that an autobiography would be a great tool to make sense of my teaching career; it would provide me a great sense of purpose in doing a dissertation.

Where I had once been hesitant to write an autobiography because of my perception that it lacked rigor, I was now beginning to embrace the thought of it. From what I understood about learning, it hinged upon making meaning out of lived experiences. As a teacher I attempted to create situations for my students where they would be given the opportunity to make sense of their world; by writing my teaching autobiography, I would be learning in the same fashion I thought was best for my students.

Reading Dewey, contemplating my dissertation, and thinking about experiences even brought back to mind some of the conversations and ideas I had had during the master's cohort. Constructivism, as I reflected, stood out in my mind as an epistemology that centered on meaningful experiences. Mr. Elliot's words echoed in my mind once again, "Constructivism is about giving students meaningful experiences that allow them to make sense of their world" (personal communication, 2000-2003). Even the book by Brooks and Brooks (1993) reaffirmed not only my

thoughts about an autobiographical dissertation, but also about what was occurring to me as I made the move to the high school. As the authors point out:

> Constructivism stands in contrast to the more deeply rooted ways of teaching that have long typified American classrooms. Traditionally, learning has been thought to be a 'mimetic' activity, a process that involves students repeating, or miming, newly presented information (Jackson, 1986) in reports or on quizzes and tests. Constructivism teaching practices, on the other hand, help learners to internalize and reshape, or transform, new information (p. 15).

I understood that one of the reasons I had been so leery of doing an autobiography for a dissertation was because of my perception of learning. Although I was leaning heavily away from traditional teaching methods (the 'mimetic' approach) in my classroom, the educational system as a whole seemed to perpetuate it in its ways of operating. I needed to do something for my dissertation that the system viewed as educationally valuable; I didn't feel the system would perceive an autobiography as valuable. As Brooks and Brooks (1993) comment, "To understand constructivism, educators must focus attention on the learner. But, opportunities for learners to learn are heavily controlled by the structure of schools" (p. 22). Contemplating these ideas and having conversations with others helped me conclude that an autobiography would be best for me, even if others thought it was of little meaning. For me and my learning, I could see no better option.

CHAPTER 17

MONDAYS WITH ELLIOT

As the doctoral classes came to a close and we were charged with the task of avoiding the 'ABD' title, I realized my chances to have deep, meaningful conversations about education would be curtailed. Without being around twenty other educators who were cooped up in a room for hours at a time, I wouldn't be encouraged to be critical of my teaching strategies the way I had been in the past. Wanting to avoid burnout or stagnation, and being newly involved in the leisure activity of running, I decided to ask Mr. Elliot if he would be interested in doing a five-mile run one day a week. I knew his pace would be much slower than what I was able to do, but I craved the intellectual stimulation I had grown accustomed to during the past five years. I called him from school. "Mr. Elliot, I know you mentioned before that you used to run quite a bit; are you still running?"

He was quick to reply, "Ah, Dan, I try to get out a few times a week. It's nothing major, but I try to keep myself active."

"Would you be interested in allowing me to tag along and pick your brain?" I responded. I didn't think he would say no, but I wasn't sure if he would be open to the idea of doing it once a week.

"Sure. That sounds like a good idea." From what I could tell he actually thought it sounded like a great idea. It was almost as if he was waiting for someone to offer to run a few miles with him. "But, I can't go as fast as you young guys, you know; if you don't mind a slower pace, I would enjoy the company."

"That's no problem. The pace is not as important as the mental stimulation." I was encouraged to hear he was willing. "Would you want to try and run every Monday? I think I could use the mental challenge as well as the physical work-out. Are you free next week?"

"I think I can do that. Let me double-check my schedule and I will shoot you an email. Let's plan on next Monday."

As we hung up, I was relieved to have finally found a forum to bounce my educational ideas around, as well as be challenged to see learning differently than what I had been accustomed to for the last twenty-six years of my life. I knew I would be able to learn so much by just listening to Mr. Elliot; I would also have the chance to bend his ear on my own ideas about education. At last, I found an outlet in which I could quench my thirst for some sort of collaboration; fifty minutes each Monday, I had my chance to challenge and be challenged by one of the most respected educators in the state. Needless to say, I couldn't wait.

The runs were not a disappointment. As we ran, albeit not at a breakneck speed, we talked about any and every issue. We didn't focus solely on educational topics, but ventured many times into politics, marriage, parenting, and even religion. No topic was taboo, but we did have some great talks that did focus on education. We discussed the educational application and misapplication of behaviorism (Kohn, 1993), discipline (Kohn, 1996), standards (Meier, 2000), competition (Kohn, 1992), teaching/learning experiences (Inchausti, 1993; Wheatley & Abshire, 2002; Wigginton, 1985), metaphors (Lackoff & Johnson, 1980), inquiry (Llewellyn, 2002), constructivism (Brooks & Brooks, 1993; Driver, 1995; Julyan & Duckworth, 1996),

and statistics (Levitt & Dubner, 2005) to name a few. The runs became a great escape from the isolation I felt teaching in the high school. And it wasn't that I thought high school teachers didn't have anything to offer, but rather that there wasn't the time, nor the desire for many of them to have these types of talks. The focus in teaching high school was not about teaching students, but instead, it appeared to be more about teaching content. By meeting with Mr. Elliot, I was able to reconnect with someone who was able to focus more directly on the needs of the students rather than the needs of the curriculum.

These "philosophical aerobics" or "Socrates runs" (taken from the title of the book *Socrates café* by Phillips [2001]) as we sometimes called them (personal communication, 2004-2006), eventually became almost a tradition for Mr. Elliot and me. Each Monday we would beat our feet on the same five-mile path. The great thing about the runs, however, was even though we ran the same trail each time, none of our five-mile journeys was the same. Each one of them was unique in its own way. Sometimes the weather would be brutally cold or windy. Sometimes the temperature would be ideal with sunny skies. Sometimes we would not even discuss educational topics, other times it would be all we talked about. On many occasions I would have questions with which we would start our runs, and the conversation would evolve to meet each of our needs. Some of our runs would start with a story about a student while others might start with a topic one of us had recently read. There have not been two runs that were the same. They are so enjoyable, in fact that we still run, every Monday, to this day.

When talking to some of my colleagues about the Monday runs, some act surprised we can even stand up after running five miles, talking all the way through the workout, nonetheless. Many of them have made comments about how they wouldn't even make it a half-mile or that they would get bored running the same course every Monday. But I have found when running with Mr. Elliot (or anyone else for that matter), the conversation and ideas of the moment take precedence over the feelings of pain or "Are we ever going to be done?" We live/run in the moment and simply enjoy the company. We don't seem to focus on the actual running as much as we do on having the conversation. It is almost as if the running is an aside to the companionship.

By using the runs as an excuse to have meaningful conversations, both Mr. Elliot and I feel we are not only benefiting physically, but also intellectually. We often comment after the runs about how enjoyable the talk was. Of course, he will sometimes admit that our pace was slightly challenging; we will occasionally even check our pulse. But most times we leave without even talking about the aerobic part of the meeting; our focus is more on what happens during the run, not the run itself.

CHAPTER 18

THE "P" WORD

While finding release in my runs with Mr. Elliot, I was also intent on working towards the completion of the Ph.D. Although I had finished the 'seat time' required, I still had to finish the general exams and then the dissertation. Strangely, while working through the doctoral program, I had been getting a strong desire to work with prospective or new teachers to try and help them navigate the educational system that I was beginning to understand. The natural progression for me was to complete the Ph.D. so I could get a job as a professor working with education majors. In a way, I knew my educational journey was one that could help other teachers through the first few years in the classroom. The experiences, the fears, the changes, and the mental shifts I had encountered would seem to lend themselves well to working with those who were choosing to enter the educational field. I had something to share.

As such, I wanted to write my general exams over topics that would help me not only understand my educational experiences in light of my foundations, but also help me if I actually became a professor of education. Luckily, the members of my doctoral committee allowed me to write my exams over three related topics—the history of science, the history of science education, and autobiographical methods. Although the first two are clearly investigations into the history of science and science education, autobiography might seem, to some, to be out of place. However, autobiography is simply the written history of one's experiences, not unlike the written history of science or the teaching thereof. Each of the three topics would not

only challenge me as a teacher and learner, but also strengthen my desire to get my own educational journey on paper.

While reading about the various topics, it became clear that writing the history of events is not as simple as one might imagine; the interpretation of events is influenced by opinions, emotions, and prior experiences. As with all historical accounts, including one's own when writing an autobiography, there is no one accurate depiction of the events. As Spring (2001) suggests, "there is no right answer but only differing opinions about which historical interpretation is correct" (p. 2). As such, my aim in writing about the history of science, the history of science education, and my own history, would not be to tell the 'correct' story but to try to explore the events I thought would help me make sense of my foundations as a science teacher. Although I felt I had a grasp on some of the things that encompassed my 'hundreds of years' of living, I was able to refine those ideas, and even develop some that would reinforce my decision to write my autobiography.

One of the first ideas I grappled with while working on the generals was the notion of 'proof.' Throughout history, cultures have held ideas, which as new information or knowledge became available, were shown to be inaccurate. For example, prior to the Scientific Revolution the general consensus was that the earth was the center of the universe and that planets and other celestial objects revolved around the earth. This Ptolemaic system was seen by most during the time period to be an accurate description of the nature and reality of the universe. Now, however, most people understand the motion of planets and stars using the Copernican model, which places the earth in orbit around the sun, which is now considered the center of

our solar system, and only a small fragment of a much larger universe (Brooke, 1991).

Before starting my general exams, I hadn't questioned the notion of scientific proof. But as I read through this, as well as other stories of shifts in scientific understanding (Gould, 1996; Henderson & Yount, 1996; Kuhn, 1962; MacLachlan, 1988), I began to understand that the history of science is replete with examples of changes in perspectives because of new knowledge. As Kuhn (1962) might observe, some of those changes might even cause a revolution or shift in paradigms. Where I had once naively thought the current scientific understanding was an accurate depiction of the reality of the universe, by looking at the history of what humans thought they understood about the world, I realized we are but one discovery away from a shift in paradigms. As Kuhn explains, "Normal science, the activity in which most scientist inevitably spend almost all their time, is predicated on the assumption that the scientific community knows what the world is like. Much of the success of the enterprise derives from the community's willingness to defend that assumption, if necessary at considerable cost" (p. 5). If, however, scientists discover that they really don't know what the world is like, then our understanding of how the world operates would all be thrown into question.

Where I had thought at the beginning of my teaching career that science was *the only way* to understand and know the world, I was now seeing that science is but *one way* to understand the world. I had failed to view scientific understanding in context of the historical development of ideas and thoughts. Our current understanding of the world may, in two-hundred years, be completely different than

what we understand now. Our knowledge about the world and reality is only accurate given our current rules and assumptions, and then, even to a limited degree. There is no way to prove anything; one can only give evidence to support a particular notion. In my mind, a proof would be one-hundred percent accurate; after reading the historical accounts of scientific discovery, I now doubted that anything or anyone could be so certain as to warrant the title 'proven.' Adding to my uncertainty was the new perspective that science was not as objective and emotionless as I once imagined. Brush (1974) explains some of my struggles with the history of science. "…these writing [of contemporary science historians] do violence to the professional ideal and public image of scientists as rational, open-minded investigators, proceeding methodically, grounded incontrovertibly in the outcome of controlled experiments, and seeking objectively for the truth, let the chips fall where they may" (1164). The science I was so sure of my whole life, which I had started to question during the master's program, was now a science I was only marginally confident in. Sure, I still valued what science could offer to society, but I was no longer enamored by it.

With this new perspective on scientific uncertainty and subjectivity, my thoughts on science education also changed. When I began teaching, I was certain my students would most benefit by understanding scientific principles. I saw extreme value in scientific knowledge and the 'facts' and 'proofs' of the world. Reading about the history of science education, I realized I was not alone in my faith of an understanding of scientific content (Bybee, 1993; Champagne & Bybee, 1977; DeBoer, 1991). There have been repeated calls to increase student competence in science, many times because of a perceived threat to American dominance, such as

after World War II (Klopfer & Champagne, 1990) and in response to *Sputnik* (Bybee, Harms, Ward, & Yager, 1980). However, despite those who focused science education reform efforts on the content on science (facts and proofs), many others wanted students who were familiar with the processes of science. As Bybee and others (1980) explain, "Perhaps one of the most important accomplishments of the science curriculum reforms of the 1960s was the greatly increased emphasis on inquiry processes or scientific methods as a major goal of science teaching" (p. 383). By understanding the differing aims of science education as well as the historical development of scientific thought, my classroom instructional strategies began to evolve.

In light of what I learned about the history of science and science education, I decided when starting the new school year with my high school students that we would discuss what scientists do and how they come to understand the world. My goal was to challenge their views about what was 'proven' to be true and to stretch them on what they thought science currently knew as facts and proven ideas. I talked with my class about the Ptolemaic system and how most people before the Scientific Revolution thought it was accurate; I even mentioned to my students that some people from the time-period might have even used the word 'proven' to describe their understanding. I then asked my students what we, as a society, now know about the universe. Almost all of my students talked fluently about aspects of the Copernican system with the earth in orbit around the sun, which in turn, is part of a much larger system of stars scattered throughout the universe. I then challenged my students by

asking them if this current view had been 'proven' by science. Without hesitation most, if not all, said the idea had been proven.

From what I gathered from my students, they understood this scientific concept to be absolute and virtually set in stone. And although few people would actually argue against an astronomical model that puts the earth in orbit around a sun, which is part of a much larger universe, I wanted my students to see that science was not a set of static pieces of absolute facts that described the world, but instead that science was a fluid, dynamic search for what we think the world may be like; that it is our best ideas about reality, if there really is such a thing.

Seeing my students with such a limited view on how science worked, I decided to focus on the processes that scientists used in trying to understand the world. Coincidently, some of the students in my class were the same ones I taught while teaching sixth and seventh grade. I knew my teaching style from the past (which to me seemed built upon traditional teaching methods and a blurred view of science, and one in which I was trying so desperately to shake) had focused so much on the content of science that it would be difficult to create lessons and activities that offered students the chance to see the scientific endeavor as a process of mistakes, successes, setbacks, and advances. Now, I was determined to expose my students to the processes scientists use to learn about the world as well as to continue to work at my own focus on the process of student learning. In reading about constructivism in science education, I was compelled to once again refine what I did with my students. As Julyan and Duckworth (1996) explain:

> These trademarks of a constructivist classroom may well be inconsistent with the view of science as a static body of facts. However, they are not at all inconsistent with the view of science as an active pursuit. Some teachers, along with practicing scientists, value exploration and believe that exploration will lead one to significant understanding. In both professions, it takes time to make the most of the explorations. (p. 71)

In an effort to better understand and use scientific processes in my room, I turned to the *National science education standards* (National Research Council, 1996), the National Science Teacher's Association, books about science inquiry and constructivism (Driver, 1995; Juylan & Duckworth; 1996; Llewellyn, 2002), and stories about historical figures in science (Sobel, 2002; Watson, 1980). I recognized that, according to what I understood about learning and science education (Bauer, 1992; Brooks & Brooks, 1998; DeBoer, 1991; Dewey, 1938), the most meaningful way to teach science was to give students valuable experiences that would allow them the opportunity to construct their own understanding within a social setting not only about the science content, but also about the processes science uses. As Driver (1995) explains, "The teacher needs to provide the necessary experiences to enable students' science understanding to relate to events and phenomenon. However, experience by itself is not enough. It is the *sense* that students make of it that matters" (399).

When I had tried a similar approach with my seventh-graders and their plant experiments, I wasn't as involved in making sure they were making sense out of the experiences they were having. I was doing what Driver labels as "discovery

perspective" where the teacher is "simply a provider of experiences" (p. 399). Now I could see how I was to be more involved in the students' learning process. By working closely with the groups and probing them on their understanding of what was occurring in their experiments or in their groups, I was able to truly guide them to a better understanding of science. Now, I was actively engaged with each group, asking questions and checking for understanding. I felt this is what I should have been doing all along. In short, our classroom became a micro-scale model of the scientific community. I started giving my students more open-ended lab questions, which required they work in groups to create experiments (and/or observe and measure phenomena, evaluate data, classify objects, model the world) and make sense of those observations. As Driver (1995) explains, "learning science involves being initiated into the culture of science" (p. 395), and that is what I wanted for my students and my classroom—a culture of science.

I also had the students give presentations to their peers about what they concluded about certain questions so we as a class could evaluate their data in light of other groups' data and conclusions. Driver's (1995) views on constructivist science teaching added to my newfound views of teaching science. As she explains:

> Scientific knowledge needs to be presented explicitly and implicitly as being personally and socially constructed. Theories need to be seen as provisional, not absolute. This contrasts with perspectives implicit in other teaching approaches that portray scientific knowledge as objective, unproblematic, and fixed (often the picture emerging from textbooks or formal lectures), or as discovered through individual empirical inquiries; a perspective that is

implicit in naïve process approaches or discovery learning approaches to science teaching. (pp. 398-399)

While *doing* science in my classroom, I was surprised at how many different ways students could solve a single problem, and also about how many different conclusions could be reached based on those differing methods. There were times when six different groups from one class, which all were given the same question, would reach four different conclusions about an answer to a question. It opened up a great time of sharing and discussing about what science was and what happens when scientists don't agree on the answers. After creating these types of experiences, I felt my students, as well as myself, were beginning to appreciate the applications and limitations of the scientific process. Driver (1995) continues:

> This social dimension to the construction of scientific knowledge has resulted in the scientific community sharing a view of the world involving concepts, models, conventions, and procedures…. These ideas, which are constructed and transmitted through the culture and social institutions of science, will not be discovered by individuals through their own empirical inquiry. (p. 395)

I even began to share my thoughts with my colleagues at the high school on professional development days and at department meetings. Some of them were quite interested; a few even began doing the same types of things in their own science classroom within weeks of the professional development day.

As my confidence in pedagogy was waxing, a development at home would have me doubting other parts of my life and my understanding about what I actually

knew about learning. It began as I arrived home one day after work, my wife greeting me at the door.

"Welcome home toots," she said, dawning a sheepish grin. "How was your day?"

"It wasn't bad. Busy of course, but that's not uncommon."

We exchanged the ritualistic kisses and hugs and then, she took my hand and led me past the living room and into our bathroom. As I walked in, I noticed a small pen-looking object on the vanity. She pointed at it. "Here, look at this."

Not having much of an idea what it was, I took a closer look. At first I thought it was a digital thermometer used for checking body temperature. I couldn't imagine why she would have me look at a thermometer, but she was a nurse and she had been known to do some interesting, dare I say weird, things. But as I got a better view, it looked less and less like a pen or a thermometer and more like a pregnancy test. "Is this what I think it is?" I said with a soft, composed tone.

She responded, "Congratulations, we are going to be parents!"

At that moment, my heart raced and my mind filled with thoughts of excitement and joy about being a dad and actually having a child. "Are you serious? Is this for real?" I exclaimed.

"It is due the first week of May. We are going to be parents!" Her excitement, coupled with my joy, was uncontainable. We were both so thrilled with anticipation and hope about our future. That hope and anticipation, however, quickly turned to fear and trepidation as I thought about what I knew, or more precisely, what I didn't know about being a parent. I had read very little, if any, on raising kids or

interacting with young kids. I felt comfortable being around a classroom of twenty to thirty hormonally juiced adolescents, but being around a crying, dirty baby was something completely different.

Having found success in the past dealing with my ignorance through reading and talking to others, my wife and I both decided we should do as much reading on the topic as possible and get advice from our friends on how to deal with being parents. Throughout the nine months of being pregnant we both did what we could to learn as much as could about what was involved in being good effective parents. Honestly, the reading did very little to calm my fears. My wife seemed much more comfortable with the whole notion of being a mom, but I was very unsure about how to be a dad.

When our son was finally born on April 30, 2005, all the stuff I read in books and heard from friends seemed to become but a fog in my mind. My wife even mentioned that her maternal instincts were much more valuable than the stuff she read. She did say that the one piece of advice a friend gave her made the most sense of all the suggestions we got; it was about 'reading your child.' We both had focused so much on what others thought about being parents, that we neglected our own instincts. I searched for understanding about raising kids, and although I was leery of 'scientific' evidence, I still fell in the trap of looking at what the 'experts' said about parenting. I found myself having a limited view of knowledge. I was unsure and unconfident about the power of parental instinct, but instead I was more focused on what other people's experience had told them. And even though their experiences were valuable to them, my wife and I both realized that we needed to focus on

knowing and responding to the needs of *our* son and using our own instincts to guide our decisions. In essence, he was to be our book to read. The more we knew about him, the better parents we could be.

Granted, we still sought, and still seek out, the advice of others (such as Mr. Elliot, family, and friends), but we both are less obsessed about screwing up and more concerned about how we can better know not only our son's needs, but also each other's. We have learned to lighten up and have fun with parenting. It is one of the greatest privileges I have ever known.

Surprisingly, the light-heartedness I am learning from being a parent has transferred into my teaching. I can now see my students as the son or daughter of a parent and that has helped me to focus more on the needs of my students more. When I talk to parents now, we share a common bond that previously was never there—the bond of being a parent.

CHAPTER 19

FINAL THOUGHTS

As mentioned in the introduction, when I first began teaching, I never thought I would be writing my autobiography, especially as a final research project for a doctoral program. However, my feelings of doubt about the significance and meaning of *my* story apparently are quite common. There is very little autobiographical research on science teachers coming to grips with their metaphors about teaching, or on science teachers discovering the intimate connection between their understanding of the history and nature of science to their classroom teaching methods (Caine & Caine, 1997; Driver, 1995). My perspectives, however, have been transformed over the past seven years. Writing about my experiences during this transformation has truly been a meaning-making process for me, not only as a teacher, but also as a learner. Looking back on my decision to write my autobiography, I couldn't imagine being the teacher I am today without it. The notion of *currere*, of running a race and focusing on the running, has helped me to focus on the stories of my own journey, to try and make sense out of what I experienced during the journey.

Reading through the literature on autobiography (Shon, 1991), I came across a line that now has profound meaning for me. It is from T.S. Eliot's *Four Quartets*— "We had the experience but missed the meaning." Although I have never been particularly interested in poems, short stories, or literature, this line struck a cord. It not only is personally applicable to my own experiences, but also to the experiences that occur in my classroom, with my students.

I desire, and sometimes feel successful at giving my students experiences they can relate to and find meaning in. Just this past week, my high school biology class was discussing types of learning in animals, and the topic of conditioning came up. I had no pre-planned intentions of spending the entire hour discussing with my students the various applications, and possible misapplications, of conditioning and behaviorism, but that is exactly what happened. Virtually every student in the class was deeply involved in trying to figure out how others (teachers, including me, schools, parents, society, and societal systems) had tried to manipulate them by offering rewards or threatening punishment. We talked at great length about what motivated them to do right or not to do wrong, about what grades meant, and about the meaning of the upcoming state standardized tests. I was able to discuss what Kohn wrote about in his books *Punished by rewards* (1993) and *Beyond discipline* (1996). Several students, after the bell had sounded, stayed after and asked questions; they wanted to know more about what we had just discussed. There were a few who even mentioned that the discussion was the best high school class they had been in all year.

Not surprisingly, many of my comments and questions I posed were a direct result of the meaning I had made while reflecting on the experiences written in the previous pages. I told the students in this particular class something I would have never imagined myself doing seven years ago. I admitted to them that I had no idea what grades meant, that I was clueless about the meaning of an 'A' or any other letter on a report card; I told them it may just be a misguided attempt to employ conditioning to force students to learn. Many of them looked surprised that a teacher

would be admitting that, but I was honest. I explained I had been searching for the answer to grades for several years now, but had yet to find answers I could live with.

Although I don't know precisely what each student took from the class discussion, I feel that most, if not all of my students, were challenged by what was said. Maybe the ideas even perturbed a few of them enough to search for something other than behaviorism to explain their own behaviors as well as others or to search out the meanings of their own grades in school and in my science class. Looking back at my own change in perspective, this seems to be one of the things that caused me to stop and reflect on what I knew—a perturbation about what I thought I understood about the world. And it seems much of my transformation, ironically, was based on what I understood about science. This notion was once again brought to light as I read and reflected on an article by Lorsbach and Tobin (1992).

Coming from a strong science content background, I viewed the concepts and ideas in science to be static and objective explanations about the world. I was never given notes or lectured to about science being absolute and static, but that is what I believed. As such, my views on teaching science were to fill my students with the facts and knowledge I learned in my years of being filled by others. Lorsbach and Tobin summarize this teaching perspective I held when I began my career:

> The epistemology that is dominant in most educational settings today is similar to objectivism. That is to say, most researchers view knowledge as existing outside the bodies of cognizing beings, as beings separate from knowing and knowers. Knowledge is "out there," residing in books, independent of a thinking being. Science is then conceptualized as a search for

> truths, a means of discovering theories, laws, and principles associated with reality. Objectivity is a major component of the search for truths which underlie reality; learners are encouraged to view objects, events, and phenomenon with an objective mind, which is assumed to be separate from cognitive processes such as imagination, intuition, feelings, values, and beliefs (Johnson, 1987). As a result, teachers implement a curriculum to ensure that students cover relevant science content and have opportunities to learn truths which usually are documented in bulging textbooks. (p. 5)

My views on an objective science drove my teaching philosophy—a philosophy that sought to fill students with the facts and truths of the content in an efficient, orderly, and controlled classroom that functioned like a well-oiled machine, all the while neglecting the processes that science uses. Although I gave my students lab opportunities, it was more about them verifying the facts I had already filled them with than truly making their own meaning about the world.

Contrast that perspective with the one I currently hold that places the process of understanding in much higher regard than the actual content of science. Because I understand science to be one method of attempting to understand the world using our limited senses and attempting to construct that understanding in light of our limits (i.e., subjectivity), teaching the content of science is not nearly as important as working with my students on the scientific processes and working out scientific problems. The Lorsbach and Tobin article, again, highlights this perspective:

> Thus, from a constructivist perspective, science is not the search for truth. It is a process that assists us to make sense of our world. Using a constructivist

> perspective, teaching science becomes more like the science that scientists do; it is an active, social process of making sense of experiences, as opposed to what we now call "school science." Indeed, actively engaging students in science…is the goal of most science education reform. (p. 5)

This change in perspective is one of, if not the major change that makes the most sense to me after putting my story into words. It seems my understanding of science is what fueled my pedagogy. Although completely unaware of this connection when I entered teaching, I now can identify a teacher's viewpoints on the history and nature of science (and knowledge in general) just by observing how they teach. Those who teach science as vocabulary terms, definitions, and predetermined labs seem to view current scientific knowledge as factual, unchanging, proven, and disconnected from the learner. The teachers also view the textbook as the primary source for learning, and even if students are given experiences (in labs or in groups) they are done to reinforce what the teacher or the textbook has already 'given' to the student. The *processes* teachers use communicate volumes about the *content* of science, and in fact, the processes may unknowingly communicate more about the content than the content itself. Postman and Weingartner (1969) reinforce this connection:

> "The medium is the message" implies that the invention of a dichotomy between content and method is both naïve and dangerous. *It implies that the critical content of any learning experience is the method or process through which the learning occurs*. Almost any sensible parent knows this, as does any effective top sergeant. It is not what you say to people that counts; it is

> what you have them *do*. If most teachers have not yet grasped this idea, it is not for lack of evidence. It may, however, be due to their failure to look in the direction where the evidence can be seen. In order to understand what kinds of behaviors classrooms promote, one must become accustomed to observing what, in fact, students actually *do* in them. (p. 18)

In my undergraduate teacher training classes, I never reflected on how the processes I used in my classroom would communicate content to my students. My understanding of the history and nature of science allowed me to be confident in the textbook definitions and my spoken words. Instead of valuing the methods of science and students' perspectives on science content, I valued the 'objective' and 'absolute' knowledge that was already discovered. I was communicating volumes about the methods and content of science simply by what I had students *doing* in my classroom.

By writing my story, I was able to make this connection and will be able to apply it when I help future teachers grapple with the intimate relationship between the 'content' and 'methods' of teaching. I hope to encourage future teachers to explore their own metaphors about teaching and learning, to analyze their perspectives on 'absolute' knowledge and the nature and history of science, and to examine how those views influence their teaching methods and beliefs about learning. In short, when I begin working with new or future teachers, I will strongly encourage them to seriously reflect upon knowing, learning and their role in facilitating the process, just as I did when writing my story.

However, my own reflective process of writing my autobiography was a difficult process because of what I 'saw' myself doing as young teacher. Writing

about those first few years, I was constantly shaking my head back and forth or raising an eyebrow at the things I did in the classroom. I almost felt as though the thoughts I had were not my own; they didn't make sense. I wondered about what I was thinking, even though it was my own actions and my own thoughts I was questioning. It was difficult to imagine myself as a teacher with the perspectives I had seven years ago. Lorsbach and Tobin (1992) also comment on this aspect of teacher change:

> Our research also indicates that as teachers made transitions from objectivist to constructivist oriented thoughts and behaviors their classroom practices changed radically (Lorsbach, Tobin, Briscoe, & LaMaster, In Press; Tobin, 1990). It seemed as if many traditional practices no longer made sense to teachers. Specifically, teachers recognized that learning and making sense of what happens rests ultimately with the individual learners. Learners need time to experience, reflect on their experiences in relation to what they already know, and resolve any problems that arise. (p. 7)

Just today while at school, this radical change in my perspectives on teaching was highlighted, once again. I was in the final meeting with an entry-year teacher I am working with as part of state program to help new teachers; many times I saw myself in the things this entry-year teacher did. Although he was well-versed in science (so much so, in fact, that he was recently accepted into medical school), he never took educational courses. As such, he seemed to be strongly persuaded by what science was and could do; it impacted his teaching the same way it impacted mine. His views on science seemed to mirror my views of seven years ago. The way he

taught, which was not unlike mine as an entry-year teacher, was perfectly logical to him and to me because of what he understood about science, objectivity, and truth. And in talking with him about his teaching philosophy, he echoed the mindset I had as a new science teacher. He wanted to do more 'hands-on' activities, and he wanted his students to work in groups, but he really couldn't explain why. He couldn't explain why he thought lecturing was so effective, other than "It worked for me while I was in school." But I think I understand; I think it is because that is where I was seven years ago on my first day teaching sixth grade science. I wasn't really teaching sixth-graders, I was teaching science, a science that was factual, objective, and static. That is the mindset this teacher seemed to have.

And although it seems awkward now to teach with that perspective, I can't fault him nor do I criticize him for teaching the way he thinks is best, the way that worked for him while he was in school. That is the way I once understood the world. But now, I see the world differently; I have constructed my own understanding about what it means to be a teacher. And not a *science* teacher per se, but a *student* teacher, or even better, as a *fellow learner*. I have been bettered by making my own meaning about my profession, and I feel every teacher should take the opportunity to do some constructing of their own, to investigate what their foundations are made of, to talk with other teachers about what it actually means to teach or better yet, what it really means to learn. I feel I have jogged a path that has helped me understand what my foundations are made of, and I didn't jog the path alone. And the desire is still there to continue questioning my ideas and my thoughts about life, learning, and teaching. I still want to understand more of my foundations. As the St. Augustine quote stated

at the beginning of this dissertation, people think about some awesome things in life, things like the motion of the stars and the huge waves of the sea, but “they pass by themselves without wondering.” After writing my autobiography, I want to encourage that same sense of wonderment in fellow educators, because now, as I pass by myself *I can’t help but to wonder*

REFERENCES

Anytime Anywhere Chemistry Experience. (2000). *Burning calories laboratory* Retrieved July 20, 2005, from http://aa.uncwil.edu/reeves/onlinelabs/Burning%20calories/expBC.htm

Ayers, W. (1992). In the country of the blind: Telling our stories. In W. Schubert & W. Ayers (Eds.), *Teacher lore* (154-158). New York: Longman

Bauer, H. (1992). *Scientific literacy and the myth of the scientific method*. Chicago: University of Illinois Press.

Berliner, D. (1990). If the metaphor fits, why not wear it? The teacher as executive. *Theory Into Practice*, 29(2), 85-93.

Block, J., & Yuker, H. (1992). *Can you believe your eyes?* USA: Brunner/Mazel, Inc.

Brooke, J. (1991). *Science and religion: Some historical perspectives*. New York: Cambridge University Press.

Brooks, J., & Brooks, M. (1993). *In search of understanding: Thec ase for the constructivist classroom*. Alexandria, VA: Association for Supervision and Curriculum Development.

Brooks, M., & Brooks, J. (1999). The courage to be constructivist. *Educational Leadership*57(3), 18 -25.

Bruice, P. (1995). *Organic chemistry*. Upper Saddle River, NJ: Prentice Hall.

Bruner, J. (1966). *Acts of meaning*. Cambridge, MA: Harvard University Press.

Brush, S. (1974). Should the history of science be rated X? *Science*, 183, 1164-1172.

Bullough, R., & Pinnegar, S. (2001). Guidelines for quality in autobiographical forms of self-study research. *Educational Researcher*, 30(3), 13-21.

Butt, R., & Raymond, D. (1987). Arguments for using qualitative approaches in understanding teacher thinking: The case for biography. *Journal of Curriculum Theorizing, 7*(1), 62-93.

Butt, R., Raymond, D., & Yamagishi, L. (1988). Autobiographical praxis: Studying the formation of teachers' knowledge. *Journal of Curriculum Theorizing,* 7(4), 87-134.

Bybee, R. (1993*). Reforming science education: Social perspectives and personal reflections*. New York: Teachers College Press.

Bybee, R., Harms, N., Ward, B., & Yager, R. (1980). Science, society, and science education. *Science Education*, 64(3), 377-395.

Caine, R., & Caine, G. (1997). *Education on the edge of possibility*. Alexandria, VA: ASCD.

Callahan, R. (1962). *Education and the cult of efficiency*. Chicago: University of Chicago Press.

Capra, F. (1996). *The web of life: A new understanding of living systems*. New York City: Anchor Books.

Capra, F. (1982). *The turning point: Science, society, and the rising culture*. New York City: Simon & Shuster.

Carnegie Council on Adolescent Development. (2000). *Turning points 2000: Educating adolescents in the 21st century*. New York: Teachers College Press.

Cate, J., Vaughn, C., & O'Hair, M. (2006). A 17-year case study of an elementary school's journey: From traditional school to learning community to democratic school community. *Journal of School Leadership*, 16(1), 86-110.

Center for Inquiry Based Learning. (2000). *How much sugar is in bubble gum?* Retrieved December 4, 2005, from http://www.biology.duke.edu/cibl/exercises/bubble_gum.htm.

Chacon, H. (2002). The making of a bilingual science educator: An autobiographical study. *ProQuest Information and Learning Company*. (UMI No. 3072242).

Champagne, A., & Bybee, L. (1977). A sixty-year perspective on three issues in science education. *Science Education*, 61(4), 431-452.

Clandinin, D., & Connelly, F. (1991). Narrative: Story in practice and research. In D. Schon (Ed.), *The reflective turn: Case studies in and on educational practice* (pp.258-279). New York: Teachers College Press.

Clandinin, D., & Connelly, F. (2000). *Narrative inquiry: Experience and story in qualitative research*. San Francisco: Jossey-Bass, Inc.

Collins, E., & Green, J. (1990). Metaphors: The construction of a perspective. *Theory Into Practice*, 29(2), 71-77.

Cranton, P. (1994). Self-directed and transformative instructional development. *The Journal of Higher Education*, 65(6), pp. 726-744.

Davis, N. (1996). Looking in the mirror: Teachers' use of autobiography and action research to improve practice. *Research in Science Education*, 26(1), 23-32.

DeBoer, G. (1991). *A history of ideas in science education: Implications for practice*. New York: Teachers College Press.

Dewey, J. (1938). *Experience and education*. New York: Touchstone.

Dewey, J. (1944). *Democracy and education: An introduction to the philosophy of education*. New York: Simon & Schuster.

Dewey, J. (1956). *The child and the curriculum / The school and society*. Chicago, IL: The University of Chicago Press.

Doll, W. (1993). *A post-modern perspective on curriculum*. New York: Teachers College Press.

Driver, R. (1995). Constructivist approaches to science teaching. In L. Steffe & J. Gale (Eds.), *Constructivism in education* (pp. 385-400). Hillsdale, NJ: Lawrence Erlbaum Associates.

Eisner, E. (1991). *The enlightened eye: Qualitative inquiry and the enhancement of educational practice*. New York: Macmillan.

Evolution & the Nature of Science Institutes (1999). *Mystery boxes: Uncertainty and collaboration*. Retrieved July 20, 2005, from http://www.indiana.edu/~ensiweb/lessons/mys.box.html

Fleener, M. (2002). *Curriculum dynamics: Recreating heart*. New York: Peter Lang Publishing, Inc.

Folkenflik, R. (Ed.), (1993). *The culture of autobiography: Constructions of self-representation*. Stanford, CA: Stanford University Press.

Franzosa, S. (1992). Authoring the educated self: Educational autobiography and resistance. *Educational Theory*, 42(4), 395-412.

Freire, P. (1993). *Pedagogy of the oppressed*. New York: The Continuum International Publishing Group Inc.

Gleick. J. (1987). *Chaos: Making a new science*. New York: Viking Press.

Gould, S. (1996). *The mismeasure of man*. New York: W. W. Norton & Company, Inc.

Graham, R. (1991). *Reading and writing the self*. New York: Teachers College Press.

Grossman, L. (2006). The trouble with memoirs. *Time*, 167(4). Retrieved May 2, 2006, from TimeArchive database.

Gusdorf, G. (1980). Conditions and limits of autobiography. In J. Olney (Ed.), *Autobiography: Essays theoretical and critical* (pp. 28-48). Princeton, NJ: Princeton University Press.

Gutek, G. (2001). *Historical and philosophical foundations of education: A biographical introduction* (3rd ed.). Upper Saddle River, NJ: Prentice-Hall, Inc.

Hecht, E. (1994). *Physics: Algebra/Trig*. Pacific Grove, CA: Brooks/Cole.

Henderson, H., & Yount, L. (1996). *The Scientific Revolution*. San Diego, CA: Lucent Books.

Hord, S. (1997). *Professional learning communities: Communities of continuous inquiry and improvement*. Austin, TX: Southwest Educational Development Laboratory.

Huffman, J., & Hipp, K. (2003). *Reculturing schools as professional learning communities*. Lanham, MD: Scarecrow Education.

Hurwitz, N., & Hurwitz, S. (2003). Tests that count. In J. Noll (Ed.), *Taking sides: Clashing views on controversial educational issues* (12th ed.) (pp. 150-158). Guilford, CT: McGraw-Hill/Dushkin.

Inchausti, R. (1993). *Spitwad sutras: Classroom teaching as sublime vocation*. Westport, CT: Bergin & Garvey.

James, W. (1958). *Talks to teachers*. NY: Norton.

Jensen, E. (1998). *Teaching with the brain in mind*. Alexandria, VA: ASCD.

Julyan, C., & Duckworth, E. (1996). A constructivist perspective on teaching and learning science. In C. Fosnot (Ed.), *Constructivism: Theory, perspectives, and practice* (pp. 55-72). New York: Teachers College Press.

Kaestle, C. (1973). *Joseph Lancaster and the monitorial school movement: A documentary history*. NY: Teachers College Press.

Klopfer, L., & Champagne, A. (1990). Ghosts of crisis past. *Science Education*, 74(2), 133-154.

Kohn, A. (1992). *No contest: The case against competition*. New York: Houghton Mifflin Company.

Kohn, A. (1993). *Punished by rewards: The trouble with gold stars, incentive plans, A's, praise, and other bribes*. New York: Houghton Mifflin Company.

Kohn, A. (1996). *Beyond discipline: From compliance to community* Alexandria, VA: ASCD.

Kozol, J. (1991). *Savage inequalities*. New York: Crown Publishers.

Kozol, J. (2000). *Ordinary resurrections: Children in the years of hope*. New York: Crown Publishers.

Kridel, C. (Ed.). (1998). *Writing educational biography: Explorations in qualitative research*. New York: Garland Publishing, Inc.

Kuhn, T. (1962). *The structure of scientific revolutions* (3rd ed.). Chicago: University

of Chicago Press.

Lackoff, G., & Johnson, M. (1980). *Metaphors we live by*. Chicago: The University of Chicago Press.

LessonPlanPage.com. (2005). *The five senses*. Retrieved July 20, 2005, from http://www.lessonplanspage.com/ScienceFiveSensesInDepth34.htm.

Levitt, S., & Dubner, S. (2005). *Freakonomics: A rogue economist explores the hidden side of everything*. New York: HarperCollins.

Lintschinger, K., & Cohen, A. (Producers) & Capra, B. (Director). (1990). *Mindwalk* [Motion Picture]. USA: Paramount Pictures.

Llewellyn, D. (2002). *Inquire within: Implementing inquiry-based science standards*. Thousand Oaks, CA: Corwin Press, Inc.

Little, J. (1987). Teachers as colleagues. In V. Richardson-Koehler (Ed.), *Educator's handbook* (pp. 491-518). White Plains: Longman.

Little, J. (Summer 1990). The persistence of privacy: Autonomy and initiative in teachers' professional relations. *Teachers College Record* 91(4), 509-536.

Lorsbach, A., & Tobin, K. (1992). Constructivism as a referent for science teaching. *National Association for Research in Science Teaching Newsletter,* 30, 5-7.

MacLachlan, J. (1988). *Children of Prometheus: A history of science and technology*. Toronto, Canada: Wall & Emerson, Inc.

Marshak, D. (2003). No child left behind: A foolish race into the past. *Phi Delta Kappan*, 85(3), 129-131.

Marshall, H. (1990). Metaphor as an instructional tool in encouraging student teacher reflection. *Theory Into Practice*, 29(2), 128-132.

Marzano, R., Pickering, D., & Pollock, J. (2001). *Classroom instruction that works: Research-based strategies for increasing student achievement*. Alexandria, VA: ACSD.

Mattingly, C. (1991). Narrative reflections on practical actions. In D. Schon (Ed.), *The reflective turn: Case studies in and on practice* (pp. 235-256). New York: Teachers College Press.

McMurray, J., & Fay, R. (1995). *Chemistry*. Englewood Cliffs, NJ: Prentice-Hall, Inc.

Meier, D. (2000). *Will standards save public education?* Boston, MA: Beacon Press.

Merriam, S. (1998). *Qualitative research and case study applications in education*. San Francisco, CA: Jossey-Bass, Inc.

Mezirow, J. (1991). *Transformative dimensions of adult learning*. San Francisco, CA: Jossey-Bass.

Millies, P. (1992). The Relationship between a teacher's life and teaching. In W. Schubert and W. Ayers (Eds.), *Teacher lore* (25-42). New York: Longman.

Molloy, J. (1975). *Dress for success*. New York: Warner Books

Moustakes, C. (1961). *Loneliness*. New York: Prentice Hall.

Moustakes, C. (1994). *Phenomenological research methods*. Thousand Oaks, CA: Sage Publications.

National Middle School Association. (1982). *This we believe.* Columbus, OH: National Middle School Association.

National Middle School Association. (2004). *NMSA research summary: Interdisciplinary teaming*. Retrieved April 15, 2006, from http://www.nmsa.org/Research/ResearchSummaries/Summary21/tabid/250/Default.aspx.

National Research Council. (1996). *National science education standards*. Washington, DC: National Academy Press.

Nebel, B., & Wright, R. (2000). *Environmental science: The way the world works*. Upper Saddle River, NJ: Prentice Hall.

Noll, J. (Ed.), (2003). *Taking sides: Clashing views on controversial educational issues* (12th ed.). Guilford, CT: McGraw-Hill/Dushkin.

Norum, K. (2000). *What stories tell: Storying and restorying public education*. Paper presented at the American Educational Research Association Annual Meeting, New Orleans, April 24-28. (ERIC Document Reproduction Service No. ED 451 594).

Olney, J. (Ed.), (1980). *Autobiography: Essays theoretical and critical*. Princeton, NJ: Princeton University Press.

Padilla, M., Miaoulis, I., & Cyr, M. (2000). *Science explorer*. Needham, MA: Prentice Hall.

Perkins, D. (2001). The many faces of constructivism. In F. Schultz (Ed.), *Annual editions: Education 2001-2002* (28th ed.) (pp. 176-179). Guilford, CT: Graw-Hill/Dushkin.

Phillips, C. (2001). *Socrates café: A fresh taste of philosophy*. New York: W.W. Norton & Company, Inc.

Piaget, J. (1973). *To understand is to invent*. New York: Grossman.

Pinar, W. (1975). *Curerre*: Toward a reconceptualization. In W. Pinar (Ed.), *Curriculum theorizing: The reconceptualists* (pp. 396-414). Berkeley, CA: McCutchan.

Pinar, W. (Ed.), (1975). *Curriculum theorizing: The reconceptualists.* Berkeley, CA: McCutchan.

Postman, N. & Weingartner, C. (1969). *Teaching as a subversive activity*. New York: Dell Publishing Co.

Postman, N. (1992). *Technopoly: The surrender of culture to technology*. New York: Vintage Books.

Rainer, T. (1997). *Your life as story: Discovering the "New Autobiography" and writing memoir as literature*. New York: Penguin Putman, Inc.

Richardson-Koehler, V. (Ed.). (1987). *Educator's handbook.* White Plains: Longman.

Ritchie, J., & Wilson, D. (2000). *Teacher narratives as critical inquiry: Rewriting the script.* New York: Teachers College Press.

Roth, W. (2000). Autobiography and science education: An introduction. *Research in Science Education*, 30(1), 1-12.

Schmoker, M. (1999). *Results: The key to continuous school improvement*. Alexandria, VA: ACSD.

Schon, D. (1983). *The reflective practitioner: How professionals think in action*. New York: Basic Books.

Schon, D. (Ed.). (1991). *The reflective turn: Case studies in and on educational practice*. New York: Teachers College Press.

Schubert, W., & Ayers, W. (Eds.). (1992). *Teacher lore: Learning from our own experiences*. New York: Longman.

Schultz, F. (Ed.). (2001). *Annual editions: Education 2001-2002* (28th ed.).

Guilford, CT: McGraw-Hill/Dushkin.

Science horizons (1993). USA: Silver Burdett Ginn, Inc.

Seibert, C. (2006). Unintelligent design. *Discover*, 27(3), 32-39.

Senge, P. (2000). *Schools that learn*. New York: Doubleday.

Slavin, R. (1997). *Educational psychology: Theory into practice* (5th ed.). Boston: Allyn and Bacon.

Sobel, D. (2002). NOVA, "Galileo's battle for the heavens," *His place in history*. Retrieved June 28, 2004, from http://www.pbs.org/wgbh/nova/galileo/science.html.

Southwest Educational Development Laboratory. (1995). *Building an understanding of constructivism*. Retrieved April 9, 2006 from http://www.sedl.org/scimath/compass/v01n03/understand.html

Spring, J. (2001). *The American school: 1642 – 2000* (5th ed.). NY: McGraw-Hill Companies, Inc.

Sprinkler, M. (1980). Fictions of the self: The end of autobiography. In J. Olney (Ed.), *Autobiography: Essays theoretical and critical* (pp. 321-342). Princeton, NJ: Princeton University Press.

Starobinski, J. (1980). The style of autobiography. In J. Olney (Ed.), *Autobiography: Essays theoretical and critical* (pp. 73-83). Princeton, NJ: Princeton University Press.

Starr, C., & Taggart, R. (2004). *Biology: The unity and diversity of life*. Belmont, CA: Wadsworth Group.

Steffe. L., & Gale, J. (Eds.) (1995). *Constructivism in education*. Hillsdale, NJ: Lawrence Erlbaum Associates

Stryer, L. (1995). *Biochemistry* (4th ed.). NY: W.H. Freeman and Company.

Taylor, F. (1911). The *principles of scientific management*. New York: Harper & Bros.

Thomas, L. (1975). *The lives of a cell.* New York: Bantam Books.

Thomas, L. (1979). *The medusa and the snail*. New York: Penguin Books.

Tobin, K. (1990). Changing metaphors and beliefs: A master switch for teaching. *Theory Into Practice*, 29(2), 122-127.

Tomlinson, C. (1999). *The differentiated classroom: Responding to the needs of all learners.* Alexandria, VA: ASCD.

U.S. Department of Education. (2005). *No child left behind act of 2001*. Retrieved July 18, 2005, from http://www.ed.gov/legislation/ESEA02/.

Washington, B. (1993). *Up from slavery*. New York: Carol Publishing Group.

Watson, J. (1980). *The double helix: A personala ccount of the discovery of the structure of DNA*. New York: Norton.

Weade, R., & Ernst, G. (1990). Pictures of life in classrooms, and the search for metaphors to frame them. *Theory Into Practice*, 29(2), 133-140.

Wheatley, M. (1999). *Leadership and the new science: Discovering order in a chaotic world*. San Francisco, CA: Berrett-Koehler.

Wheatley, G., & Abshire, G. (2002). *Developing mathematical fluency: Activities for grades 5-8.* Bethany Beach, DE: Mathematics Learning.

Wigginton, E. (1985). *Sometimes a shining moment: The foxfire experience*. Garden

City, NY: Anchor Press/Doubleday.

Wong, H., & Wong, R. (1998). *The first days of school*. Mountain View, CA: Harry K. Wong Publications, Inc.

APPENDIX

AUTOBIOGRAPHICAL METHOD

There are few people who would argue that stories have not been a significant aspect of every culture the world has known. Whether told verbally, through paints and a canvas, or through a word processor, stories have helped to define people and their culture. Stories help us to understand who we are and how we relate to the world around us; autobiography is one of the most intimate ways that this history and tradition are understood. As Olney (1980) states, "Autobiography…offers a privileged access to an experience that no other writing can offer" (p. 13). As people have become more curious about themselves and their place in the world, autobiography as a genre has become more important, especially since the late eighteenth-century (Sprinkler, 1980).

However, autobiography as research methodology has been slow to gain acceptance in academics because of the strong prevalence of the modernist worldview, the same worldview I unknowingly adhered to when entering graduate school. Ayers (1992) discusses this dominant educational research mindset when describing the use of teacher's stories:

> Research on teaching is still dominated by…that perverse phenomenon of striving anxiously to be like the Big Guys who we imagine are doing all manner of classy things with all sorts of fancy equipment. …We need a different frame, an altered angle, if understanding people is our aim…. In teacher lore, research is not didactic, intimidating, or oppressive, but is allowed to be interpreted, shared, and creative, and always in the service of

> teachers and students. All the pseudoscientific baggage…can give way to some sort of autobiographical style, some honest accounting of how the author-researcher got where she or he was going. (pp. 154-157)

Despite, or perhaps because of, the dominance of the modernist worldview, there are a rising number of serious researchers pursuing and advocating autobiographical accounts. As Bullough and Pinnegar (2001) point out, "Self-study represents this trend away from modernism and its assumptions about legitimate knowledge and knowledge production toward broadening what counts as research" (p. 13). They continue, "the influence of the movement has touched more mainstream journals and one expects that over time self-study research will increasingly have an influence on teacher education undergraduate and graduate programs and program development efforts" (p. 14). Davis (1996) builds upon these ideas:

> In recent years the nature of educational research has changed dramatically. Not so long ago research in schools was a relatively abstracted and distanced experience with access to classrooms limited to paper and pencil instruments. However…studies have become more intense as researchers probe deeper to find meanings from the viewpoint of the participants. More recently the practice of teachers accepting roles of researchers within their own classrooms is becoming more prevalent as the value of self reflection regains attention. (p. 23)

In writing my educational autobiography, I attempted to tell the stories that influenced my thoughts about learning and teaching. It was my attempt to make

meaning out of those experiences. It was also a way, given my relative isolation while teaching in a high school, to continue questioning my deeply held assumptions. Schon (1983) argues that although teachers' isolation actually works against reflection, it is nevertheless vital to stop and question deeply held beliefs through reflection. Kohn, in his book *Punished by rewards* (1993), strongly advocates for questioning the most habitual practices in teaching and also in life. Dewey, in *Experience and education* (1938), encourages reflection in children, which is "used to organize what has been gained in periods of activity in which the hands and other parts beside the brain are used" (p. 63). Mattingly (1991) claims, "Simply asking practitioners to reflect on the stories they already tell can provide a natural bridge to serious inquiry about the very deepest layers of value and belief that undergird the decisions they make" (p. 255).

By analyzing and reflecting on my experiences, I was also able to do a better job of educating; the use of autobiography was a transforming and growing experience in itself. By reflecting on experiences that occurred in and out of the classroom, I was more responsive to student needs and conscientious of forming meaningful relationships with the kids in my classroom (Graham, 1991). By reflecting, it "is a means for teachers to participate consciously and creatively in their own development" (Millies, 1992, p. 40).

Despite my feeling of success in reflecting and making sense of my experiences, I did feel, during the initial stages of writing my story, uneasiness about creating a dissertation without the use of strong, step-by step methodology. Coming from the positivist tradition of science, I felt I would work best with a road map or

guidelines for writing an autobiography, and as such, I searched for steps and methods that would guide me as I wrote. What I found, however, was in autobiography there is a general sense in the literature that there are no agreed upon rules or methodologies with which to proceed (Bullough & Pinnegar, 2001; Folkenflik, 1993; Olney, 1980; Starobinski, 1980). Starobinski claims that "autobiography is certainly not a genre with rigorous rules" (p. 77). He even argues that one should avoid speaking of autobiographical form or style; it is the act of the individual that makes the style. Folkenflik (1993) agrees, "Autobiography, as I understand it, has norms, but no rules" (p. 13). Bullough and Pinnegar's article (2001) discusses the frustration with their self-study research special interest group in trying to understand what self-study/autobiographical research really is:

> Yet even as the signs of success mount, debate internal to the movement rages. Each time the SIG [Self-Study Special Interest Group] meets, one topic invariably enters discussion: "What is self-study?" "How can we tell whether a study is a good one?" One hears beginning professors lament a rejection of a submitted self-study journal article. Often, an accusatory finger is pointed toward journal editors who are presumed to exist in a time warp of rigid standards and social science prejudices. The lament strikes an odd chord: Certainly something other than editor prejudice may explain rejections, particularly since self-study articles have been published in many of the major education journals. Determining just what it means to be involved in self-study has proven very difficult. (p. 14)

However, despite the lack of solid methodological steps, I did find several researchers who were offering guidelines and suggestions for how autobiography could be done. Pinar (1975) is often cited for use of the term *currere* in educational experience and autobiographical writing. Instead of focusing on technical rationale, designs, and objectives, "[t]he study of *currere*, as the Latin infinitive suggests, involves the investigation of the nature of the individual experience of the public: of artifacts, actors, operations, of the educational journey or pilgrimage. …*Currere*, historically rooted in the field of curriculum, in existentialism, phenomenology, and psychoanalysis, is the study of educational experience" (p. 400).

I immediately made a connection with the idea of *currere* because it has been described by using the metaphor of running a race or jogging a course (Graham, 1991; Pinar, 1975), something Mr. Elliot and I began doing when I started teaching in the high school, and something that is a hobby of my own. *Currere* is similar to the act of running; not the course one is running. The focus is not the race or the course, but what one is doing during the race or while on the course—the running. When applied to education and writing stories, the experience of learning is the focus, not the objectives and goals of the curriculum or the method and style of writing. Chacon (2002), in his dissertation, used this idea/method in writing his educational autobiography. He sought to understand his experiences as a bilingual high school science teacher and eventually a university professor. Similarly, I used the same idea, *currere*, to focus not as much on a particular style or method of doing an autobiography, but instead on making sense of the stories I felt were important and had meaning.

Despite the freedom in the method of autobiographical research, some are attempting to offer guidelines to ensure quality and rigor in such writings (Bullough & Pinnegar, 2001; Graham, 1991; Gusdorf, 1980). Bullough and Pinnegar (2001), elaborating on the work and ideas of Pinar (1975), suggest fourteen guidelines for writing quality autobiographies, and they give suggestions on how to make these research studies scholarly. "Quality self-study research requires that the researcher negotiate a particularly sensitive balance between biography and history" (p. 15). They continue:

> The balance can be struck at many times during the self-study process, but when a study is reported, the balance must be in evidence not only in what data have been gathered (from self and others) and presented, but in how they have been analyzed, in how they have been brought together in conversation. Otherwise, there is no possibility of answering the 'so what' question, the question of significance, that wise readers ask and require be answered. (p. 15)

Their guidelines, although they will not be discussed at length here, reinforce the ideas of what autobiographies should be and what autobiographies should do. They "should promote insight and interpretation," should be "about the problems and issues that make someone an educator," should "ring true and enable connection," should seek to "improve the learning situation not only for self but for the other," and they should "offer fresh perspectives on established truths" (pp.16-18).

In discussing the guidelines for quality autobiographies, Bullough and Pinnegar also discuss the importance of rigor in this type of research. "A claim to be

studying oneself does not bring with it an excuse from rigor" (p. 15). But autobiography does bring into question the idea of replicability, reliability, and objectivity. Gusdorf (1980) explains that by remembering and trying to explain our past we are distorting it furthermore because we are not the same people who lived that past; we have different experiences that allow us to reinterpret those initial experiences. But, I would argue that this very idea makes it worthwhile to reflect upon and tell those stories. By using past experiences to interpret life's events, we are simply applying what we have learned. Much like my questioning the use or misuse of grades in my own classroom, I created a new appreciation for how the school system (including myself) was attempting to manipulate student learning. I would agree with Graham (1991) in his support of autobiography because, as he indicates, all knowing is based on experience at some level. As Eisner (1991) points out, "the way in which we see and respond to a situation, and how we interpret what we see, will bear our own signature. This unique signature is not a liability but a way of providing individual insight into a situation" (p. 34).

Writing my autobiography was my opportunity to tell a story with the hopes of understanding my foundations and the historical events and people that have impacted my educational thoughts and practices. I attempted to understand the reasons why I thought and taught the way I did. I also hope others can find their own meaning in reading what I have experienced. As Norum (2000) summarizes, "When people are given the space to voice their perspectives along with a method to make their stories public, others can respond. In the process of sharing perspectives

through sharing stories, people learn more about their own perspective and are able to re-evaluate it viability" (p. 5).