Endicott College
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Montessori Education and Learning in Living Systems

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This document follows the APA Manual of Style and uses gender inclusive language

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Abstract

This paper explores connections between learning in living systems, the new sciences, and Montessori education as experienced through my studies in the Montessori Integrative Learning program at The Institute of Educational Studies at Endicott College in Beverly, Massachusetts. My practicum in living systems was conducted at two schools: La Tierra in New Mexico, and Madrasat Ardh al Amel in Algeria. The first three chapters set the context for the paper, outlining considerations for my orientation to the work, examples of environmental concerns of the Earth and the practicum sites, as well as concerns for children. An exploration of the new sciences, learning in living systems, the practicum, and considerations for school organization follow. The paper integrates practicum experience and reflection with research and literature regarding Montessori education, systems theory, autopoiesis, ecology, and educational approaches to outdoor learning environments. The appendix includes specific lesson plans for learning in living systems.

Introduction

Inspired by my studies in the Masters of Education in Montessori Integrative Learning program at The Institute of Educational Studies (TIES) at Endicott College in Beverly, Massachusetts, this paper is an exploration of the value of learning in living systems for education in the 21st century, particularly outdoor environments in a Montessori setting. This work includes an appendix of specific lesson plans that relate to school gardens and kitchens, outdoor learning, environmental education, and orientation to the Earth. In addition, the galaxies and the Universe and other characteristics of cosmic learning may provide contextual understanding of the human experience utilizing new science (science of the 20th and 21st centuries), educational theories, and Montessori philosophy.

The purpose of this paper is to highlight learning in outdoor environments, or those I refer to as living systems, using Montessori education as a context for learning. One may ask, "Why is there a need for learning in living systems or outdoor education?" and "What is the benefit for such an education in a Montessori context?" I perceive that education of children--both past and present--may be connected to environmental challenges that affect living systems of the Earth today and to face these issues, then adjusting educational practice may be a part of the resolution of these challenges in the future.

Why is there a need for learning in living systems or outdoor education?

According to sustainable educator David Orr, humanity today appears to face a myriad of environmental, social, economic, and health problems:

> If today is a typical day on planet earth, we will lose 116 square miles of rainforest, or about an acre a second. We will lose another 72 square miles to encroaching deserts, the result of human mismanagement and overpopulation. We will lose 40 to 250 species, and no one knows whether the number is 40 or 250. Today the human population will increase by 250,000. And today we will add 2,700 tons of chlorofluorocarbons and 15 million tons of carbon dioxide to the atmosphere. Tonight the earth will be a little hotter, its waters more acidic, and the fabric of life a little more threadbare. (1994, p. 7)

In addition to these facts, Orr relates that "At death, human bodies often contain enough toxins and heavy metals to be classified as hazardous waste," and that "Human breast milk often contains more toxins than are permissible in milk sold by dairies" (1994, p. 1).

Rather than separate, unconnected issues, these diverse issues may be viewed as symptoms of a systemic global orientation that needs adjustment. Such an adjustment may require changes to the very foundation of human systems that now exist on the planet.

Humanity, while looking for new ways to support a healthy planet, may find renewed value for all living beings. The kinds of adjustments necessary appear so monumental and urgent, that they may collectively be thought of as a "paradigm shift" and what Thomas Berry (1999) called to "reinvent the human--at the species level" for humanity (p. 159). Berry, who was an historian, religious scholar, and ecological advocate, wrote *The Great Work: Our Way into the Future* in which he suggested that ensuring the future of life on Earth involved a critical paradigm shift in humanity's relationship to the natural world--particularly between species. Berry wrote about how humanity arrived at this state:

> New achievements in science, technology, industry, commerce, and finance had indeed brought the human community into a new age. Yet those who brought this new historical period into being saw only the bright side of these achievements. They had little comprehension of the devastation they were causing on this continent and throughout the planet, a devastation that finally led to an impasse in our relations with the natural world. (1999, p. 2-3)

To shift out of the impasse, Berry suggested a need "to carry out the transition from a period when humans would be present to the planet in a mutually beneficial manner" (1999, p. 3). This transition could be placed into context "by relating the human venture to the larger destinies of the universe" in what he called the "Great Work" of our times (1999, p. 1). In his vision of this "Great Work," Berry called on educators to utilize the Earth as a primary teacher (1999, p. 65) and build a framework of learning centered on nature:

> In this new context of a viable human mode of being, the primary educator as well as the primary lawgiver and the primary healer would be the natural world itself. The integral Earth community would be a self-educating community within the context of a self-educating universe. (1999, p. 64)

Montessori education appears to fit this context.

What are the implications for a living systems education in a Montessori context?

Maria Montessori was a physician, scientist, and educator who established the first Montessori school, Casa de Bambini, in 1907, and who has influenced generations of educators around the world. Her influence has inspired the establishment of thousands of schools-around the world. I will offer in this paper how I believe Montessori education, by design, is uniquely oriented to support the patterns, processes, and structure of living systems. An effective way to learn about living systems may be in the context of the universe. Montessori (1948/2007) wrote about the need to present education in the context of the unfolding Universe. She wrote that "the universe is an imposing reality and an answer to all questions" (p. 5) and that the child's

> intelligence becomes whole and complete because of the vision of the whole that has been presented to [her]him, and [the child's] interest spreads to all, for all are linked and have their place in the universe on which [her]his mind is centred. (p. 6)

Similarly, Berry spoke about the need for education within the context of the universe:

> Both education and religion need to ground themselves within the story of the universe as we now know it through our empirical ways of knowing. Within this functional cosmology we can overcome our alienation and begin the renewal of life on a sustainable basis. (1999, p. 71)

As a scientist, Montessori used observation to inform her work. She spoke and wrote frequently about the problems of society as she observed them. During a lecture tour in 1946, she spoke about the age of technology and the unification of common global interests (Montessori as cited by Montessori Jr., 1976/1992, p. 70). In addition to the triumph of technological accomplishments, she asserted that humanity's ability to keep pace with those advances was lagging and that technology had become a "menace" (Montessori as cited by Montessori Jr., 1976/1992, p. 70).

In the decades following Montessori's lecture, her work was carried on by her son, Mario Montessori, and later her grandson, Mario Montessori Jr. In *Education for Human Development,* Montessori Jr.'s stated his own concerns for humanity and for education's role in the transition:

> The individual personality must develop the independence and maturity needed to see the present situation clearly and to visualize the future. It will then be possible to consider the direction in which we are going and how to influence matters so that we, with our powers of adaptability, our intelligence, and our creativity, can find a constructive way to handle our world, a world which in itself is a beautiful place to live in and which could be much more agreeable than it happens to be at the moment. (1976/1992, p. 93-94)

Montessori education is a well-established approach to education that has been used for over 100 years. A key element to the approach is the concept of Cosmic Education. Mario Montessori Jr. wrote that "Cosmic education seeks to offer the young, at the appropriate sensitive

period, the stimulation and help they need to develop their minds, their vision, and their creative power, whatever the level or range of their personal contributions may be" (1976/1992, p. 101). Montessori Jr. explained that the individual child may seek to identify one's own "cosmic task" or "the service that must be rendered by the individuals of each species to the environment on which they are dependent for their existence to maintain it in such a way that it will support their descendants, generation after generation" (1976/1992, p. 104). Finally, he suggested that "interest in special details in never activated without a prior interest in the whole" (1976/1992, p. 103). Cosmic education in the elementary grades focuses on "the whole" using the context of the universe, its development, and progression of life on Earth as unifying themes through the Five Great Lessons and imaginative stories of the development of life as we know it.

Development of inner order of the child is another key feature of Montessori education. Montessori wrote that "A form of order in nature also appears in the behaviour of children" (Montessori, 1955/2009, p. 32) and that "nature, in its process of constructing man, follows an established order" (Montessori,1955/2009, p. 32). Regarding some common conceptions of children as "unstable, lazy, disorderly, violent, stubborn, disobedient," Montessori offered that children are not inherently bad and that they may be guided towards healthy behavior in a properly prepared environment (1955/2009, p. 33). There appears to be a degree of freedom so that "the children do not become 'obedient to a teacher who gives them lessons and corrects them,' but they find their guide in the laws of nature and function normally" (Montessori, 1955/2009, p. 34). I perceive her view of natural laws as what might be considered today as living systems. Of these laws of nature, Montessori goes on to say, "what is usually called 'the Montessori Method' revolves around this essential point" (1955/2009, p. 34).

Finally, Montessori wrote stridently about the educator's responsibility to training by preparing of the environment, inviting children to work, and not interrupting them once concentration is achieved. Montessori suggested that such a training would allow one to see "the manifestations of the spirit of the child" and to fall in love with that spirit and dedicate one's self to inner transformation in order to become worthy servants of the child (Montessori, 1949/2007, pp. 226-231).

Because of the emphasis on Cosmic Education, the context of the whole, the natural development of order, and the transformation of the adult, Montessori education appears to be a good fit for education that supports learning in living systems, one to envision "that the nature of childhood can offer a solution for a problem which we adults cannot solve-that from the child [comes] the fusion of what our mind conceives only as a contrast" (Montessori, 1955/2009, p. 28-29). More information about Montessori and her approach to education will be addressed in Chapter 5, from page 85 to 101.

This paper expands upon contrasting circumstances on Earth by exploring current events that support Berry's suggestion of the need for a "species level" shift. The role of Montessori education in that shift is investigated, along with the practicum experiences, school organizations, and specific lessons that supports learning in living systems. What follows is an overview of how the paper is divided into these areas.

The Contents of This Paper

Chapter one of this paper addresses how I personally came to the work of Montessori education and learning in living systems. The second chapter outlines some of the present environmental circumstances in the Earth community, and specifically in Northern New Mexico,

and Algiers, Algeria. Chapter Three gives an overview of the present environment of the child, including children in the two practicum sites for my studies-La Tierra Montessori School in New Mexico, and Madrasat Ardh al Amel (or MAA) in Algeria. Chapter Four will examine learning in living systems and possible benefits of this kind of education. The chapter dives into the science of living systems themselves, beginning with Einstein's Theory of Relativity, which may be viewed as the catalyst for a shift from Newtonian thinking towards Wholism or Quantum thinking. Chapter Five will address how Montessori education may be a useful context for learning in living systems. (We do not make statements and find evidence to support our conclusions. We are taking the reader on a journey of discovery.)

Chapter Six is an overview of experiential and theoretical learning in the two practicum environments and the specific insights gained through work with these systems. Chapter Seven specifically looks at organizational considerations for schools operating as living systems. The conclusion integrates all of the chapters. The appendix includes the complete Learning Proposal and a compilation of lesson plans based on learning in living systems that have been prepared for use in Montessori settings. Throughout the paper, I have tried to include my personal revelations and insights through my work at TIES, my practicum sites, and the internal process of exploring a focus on living systems.

A Focus on Specific Living Systems

My specific area of focus has been oriented towards learning in living systems, which according to physicist and systems thinker Fritjof Capra (1996) is "a multiply interconnected network whose components are constantly changing, being transformed and replaced by other components" (p. 268). While studying living systems of cultural, natural, and societal structure,

I have found that my studies in the TIES program have consistently led back to an inward study of myself. Through developing understandings of modern physics and other sciences, I now identify myself as a living system. In tune with this perspective, my work at TIES has been the study of myself as a living system in a Montessori setting.

Over the last 18 months in the TIES program, I have studied living systems in two seemingly disparate lands-the arid upper Rio Grande region around Española, New Mexico, and the fertile Mediterranean strip around Algiers, Algeria. Six months into my M.Ed. program, I became the co-founder of a new public charter school, La Tierra Montessori School of the Arts and Sciences, which was approved in July 2011, and is slated to open in September 2012. About 12 months into the program, in February 2012, my family and I moved to North Africa to help establish a trilingual Montessori school, Madrasat Ardh al Amel, in Algiers, Algeria, which I had been helping develop from New Mexico for almost two years. I did not expect, with any degree of certainty, that either of these circumstances would present themselves, let alone both. Woven through my studies in the TIES program, I have observed and experienced the region, landscape, culture, and educational practices in these two settings. In each setting, I have had the opportunity to observe and examine myself.

Living Systems and Self-Reflection

Living systems may be regarded as "systems that produce themselves in a ceaseless way" and are "at the same time the producer and the product" (Varela, Maturana, and Uribe as cited by Mariotti, "Autopoiesis", 2012). Examples of autopoietic living systems may include simple cells, complex organisms, ecosystems, water and carbon cycles, the Earth, the Universe, and myself. Capra described the Earth as a "complex interweaving of living and nonliving systems

within a single web" (1997, p. 215). Capra went on to offer, "the environment itself is shaped by a network of living systems capable of adaption and creativity. So which adapts to which? Each to the other—they coevolve" (1997, p. 226).

While Montessori would not have known the language of modern physics, her words are in keeping with the co-evolving nature of living systems: "No matter what we touch, an atom, or a cell, we cannot explain it without knowledge of the wider universe" (1948/2007, p. 6). Both Montessori and Capra appear to suggest the possibility that one might find understanding of his or her life through knowledge of the universe. Philosopher Jiddu Krishnamurti, in his book *Education and the Significance of Life,* affirmed this possibility as well, "To understand life is to understand ourselves, and that is the beginning and the end of education" (1953/1981, p. 14). Therefore, it may be useful, when examining living systems, to examine both the wider universe and oneself. How might cognition and reflection relate to this examination?

Cognition, as Capra described, may actually be regarded as the process of life in a living system.

> Cognition, then, is not a representation of an independently existing world, but rather a continual bringing forth of a world through the process of living. The interactions of a living system with its environment are cognitive interactions, and the process of living itself is a process of cognition. In the worlds of Maturana and Varela, "To live is to know." (1997, p. 267)

Capra further suggested that cognition "involves the entire process of life – including perception, emotion, and behavior" (1997, p. 267) and that, in the individual, cognition is a representation of an individual's perception of the world. Using Santiago theory as a context, Capra suggested that

> what is brought forth by a particular organism in the process of living is not *the* world but *a* world, one that is always dependent upon the organism's structure. Since individual

> organisms within a species have more or less the same structure, they bring forth similar worlds. (1997, p. 270)

If knowledge of oneself leads to understanding of the wider world, and if such knowledge is constructed on an individual basis that includes perception, emotion, and behavior, then an examination of those perceptions, emotions, and behaviors may be called for.

Physicist David Bohm wrote in *On Dialogue* "all that we do is shaped and formed by our modes of thinking and communication, these patterns based on paradoxes tend to bring about confusion in every phase of life" (1996, p. 75) and suggested that "what is needed is that people be ready to give serious and sustained attention to a paradoxical pattern that has come to dominate their thinking and feeling" (1996, p. 75). Bohm further suggested that investigating the apparent paradoxes in thought could aid in solving humanity's problems:

> In essence, therefore, what is needed is to go on with life in its wholeness and entirely, but with sustained, serious, careful attention to the fact that the mind, through centuries of conditioning, tends, for the most part, to be caught in paradoxes, and to mistake the resulting difficulties for problems. (1996, p. 78)

The very idea of investigating thought may be seen as paradoxical, and changing the patterns of thought, perception, emotion, and behavior might seem like daunting tasks. Bohm gave an example of this paradox:

> I may question some belief, but I may question it through what amounts to another belief. So you have to be sensitive to the whole of what you are doing. What happens is that it seems that there is a 'doubter' who doubts. Somewhere 'back in the back' is somebody who is observing what is wrong, but he is not being observed. The very 'wrong' things which he should be looking at are in the one who is looking, because that is the safest place to hide them. Hide them in the looker, and the looker will never find them. (1996, p. 82)

Reflecting on cognition, thought, perception, emotion, and behavior are complicated tasks for any individual as Philosopher Henry David Thoreau wrote in the classic book *Walden,*

> there are continents and seas in the moral world in which every man is an isthmus or an inlet, yet unexplored by him, but that it is easier to sail many thousand miles ... than it is to explore the private sea, the Atlantic and Pacific Ocean of one's being alone. (1854/ Kindle DX version, p. 246)

I find Thoreau's statement meaningful in the context of the TIES M.Ed. program. My studies encompass inquiries into Montessori education and learning in living systems, including the living systems of La Tierra Montessori School and Madrasat Ardh al Amel, as well as the living system that is myself. Through these inquiries, I have endeavored to weave the narrative of my studies, my inner journey, and the lesson plans I have prepared to support learning in living systems. My hope is to present an interconnected web of study, experience, and practical application to illustrate how I came to this work.

Chapter 1: How I came to this work

A few years ago, near his ninth birthday, my son had some questions he was seeking to answer. He wanted to know why -- out of all the billions of galaxies, stars, and planets -- we have life on this little blue planet. He also questioned how his particular life could possibly have meaning within the enormous context of the universe. He wondered why there would be a world in which there is so much suffering, and what the purpose of it all is.

I recall struggling with these same questions while growing up in the small, isolated western town of Laramie, Wyoming years ago. Through experiencing the literature and coursework, TIES provided me with an opportunity to explore the inquiries of my son and create a dialogue about these enormous concepts. Perhaps more importantly, I have had the opportunity to reflect on my own childhood inquires and process in a deep and fascinating way the

discoveries of new perspectives for inquiry I began investigating over twenty years ago. This portion of the curriculum was quite unexpected.

The questions that my son and I shared are a part of our personal stories and our own journeys. Yet, for me, as a Montessori educator, they are integral to my experience of life and my experience of being in a Montessori classroom. The subjects are woven together in a framework of perspective and experience that color all of my interactions in the classroom. Thus, the nature and preparation of the teacher seems a likely place to start. Montessori wrote a great deal on the topic of the preparation of the teacher, as the main the concept of inner transformation of the adult.

In addition to the emphasis Montessori placed on the inner development of teachers, she also posed questions of a similar nature as those of my son in *To Educate the Human Potential:*

> What am I? What is the task of [humanity] in this wonderful universe? Do we merely live here for ourselves, or is there something more for us to do? Why do we struggle and fight? What is good and evil? Where will it all end? (1948/2007, p. 6)

Perhaps these questions were posed so that some answers could be offered using Montessori's approach to education. As an individual in the process of self-inquiry and transformation, it seems valuable to speak of my own trajectory in the context of these questions. The work of self-transformation is quite personal, necessarily so perhaps, to create lasting change in the individual perspectives on life. In that way, I rely upon the confidence on my own experiences.

I have been uncomfortable about connecting my TIES studies specifically to my own experiences throughout the program. Yet I now find the inclusion of my experience to be an essential piece of the matrix. Without contributing this piece, I feel that my particular TIES

experience, and the relating of that experience, is incomplete. And so, it is with this discomfort in sharing, that I have attempted to relate my inner process of experience and transformation.

For me, questions similar to the ones that Montessori asked emerged when I was about 12-years-old. There were a number of experiences that may have sparked the inquiry. As a child, I was passionate about dance. My life revolved around dance classes, performances, costumes, leotards, and ballet shoes. I began studying dance when I was five, taking one ballet class a week. By the time I was 12, I was one of the leading dancers in a small local dance company and I was skilled at ballet, tap, jazz, and modern dance. I had performed with several professional companies. Most nights of the week, as well as weekends, were filled with dance classes. I defined myself in terms of my dance, forming a wonderful world of creativity, beauty, and expression.

Compared to the rich environment I had in my free time, my education was somewhat less inspiring. I had been identified in elementary school as gifted. I recall being taken out of the class with the other gifted students to work on more challenging projects like advanced reading and math, spelling bees, and science projects. Though the work was more challenging, it was delivered in a similar style as in the regular classroom. Instead of the teacher standing in front of thirty students at a blackboard, we had a teacher standing in front of five or six. The work was mostly reading from texts and memorizing facts. I was not interested. I wanted to dance, to move around, to explore and find beauty-in poetry, art, music as well as other avenues.

In 1983, when I was 11-years-old and in the sixth grade, Howard Gardner proposed his theory of Multiple Intelligences. Gardner's theory centered on the concept that the prevalent perspectives of intelligence and its measurement were inadequate. He offered that "the successes

as well as the failures [in education] have occurred in the absence of an adequate framework for thinking about intelligences" (Gardner, 1983/1993, p. 5). Gardner described eight distinct types of individual learning abilities, and that children may learn best utilizing skills associated with his or her strongest abilities. Gardner's eight abilities are: "logical-mathematical, spatial, linguistic, body/kinesthetic, musical, interpersonal, intrapersonal, and naturalistic" (1993, p. xxix). Since then, the theory of multiple intelligences has been expanded with consideration for the existential or spiritual category.

Reflecting back, my sense is that many of my educational experiences in grade school were geared exclusively for students with strong skills in the logical/mathematical abilities and linguistic abilities. These students, according to Gardner, could be proficient learners in the areas of mathematics, reasoning, scientific thinking, listening to lectures, and taking notes (1993, pp. 100-105). I think I was most identified with the body/kinesthetic intelligence. Students with strong kinesthetic tendencies learn best by doing, by physically manipulating their bodies and objects in space, and by making things. With a few exceptions, this style of learning was not supported in my sixth grade class.

My sixth grade teacher, Lois Wheasler, was an older woman who had been teaching for many years in the traditional American style. Our desks were in neat rows facing the blackboard and we spent the majority of our days looking at the chalkboard while the teacher wrote information and calculations on the board, which we copied in our books. We had typical readers and textbooks. Our classroom was very strict about rules and order and the entire class waited impatiently for recess, when we could run all over the playground and be free. But for some, recess was not enough to satisfy the desire for freedom. I was one of those students and it

was early in the year that my unacceptable behaviors became often enough to firmly establish a new identity at school as a problem student.

Because of my unwillingness to comply with the teacher's rules, I spent many days in the principal's office. My mother worked for the school district in the special education department and visited my school frequently to work with clients, and she would often observe me sitting in the office when she signed in to work. Perhaps this pattern was stressful for her, as well as a personal and professional embarrassment. My mother had been a single working mom for years who was always absorbed in her work and trying to make ends meet for our family, which included my two older brothers The stress of the problems I was having at school was also felt at home.

The one release from all of these struggles at school and home was dance. The more difficult my life became elsewhere, the more I excelled at dance. In the middle of my sixth grade school year, I learned that my dance instructor would be moving out of state and closing the school. Not only was I devastated, but I also felt that my identity as a dancer was disintegrating and what remained was not just a "problem student," but also a "problem child." This would become my new identity.

It was around this time that I really began to question the purpose of life. The loss of my dance instructor was followed in the next few months by the deaths of three people to whom I was close; my aunt, a fellow dancer in the seventh grade, and my school counselor all succumbed to leukemia in the spring of 1984. To me, it seemed that my whole world was falling apart, and I could not make sense of any of it.

I have a vivid memory of the day my aunt died, whom I loved very much. It was spring, and it was a rainy, grey day. I took a long walk across town and picked lilacs--my aunt's favorite flower--crying, lamenting, and cursing God for what I perceived to be an unjust world. I remember the smell of the rain in the air, the bright cottonwood leaves fluttering in the breeze, and the smell of crushed lilacs wilting in my hands. It is a powerful memory, one that is as clear to me now as when I was eleven. Though I would not receive answers to my questions that day, the connection I made with nature may have catalyzed a life-long interest in and love of the natural world that I do not remember as having been present before. Perhaps I was beginning to explore the regions of the brain that correspond to "naturalistic intelligence," which Gardner added to his list of multiple intelligences in the 1999 book, *Intelligence Reframed.* Individuals with strong naturalistic intelligence may have heightened sense of pattern and connections in nature as well as a particular care for the environment and other species on the Earth. (Gardner, 1999, pp. 50-52).

My newly formed connection in nature became a solace over the next several years. Whenever I felt lost or confused, I would go for long walks to the parks, the wide expansive short-grass prairies behind my neighborhood, and to the hill overlooking town where the wind whipped at speeds of up to eighty miles an hour. These were my places of comfort and contemplation.

I spent much time roaming the range around my hometown of Laramie. My mother and I argued often and I was frequently in trouble at school. The situation became seemingly unbearable for my mom and she relied on the juvenile justice system. Meanwhile I had discovered poetry, philosophy, and literature and was engrossed in my own studies, which did

not happen to coincide with my studies at school. My mother would call the police to come collect me and I would pack a pile of books to read in the juvenile facility in town. This became almost a regular routine. I was searched, questioned, and locked into homes with the other "juvenile delinquents." Some of my bunkmates had been selling drugs or stealing cars. My main offenses were not listening and probably, arguing semantics to my mother's consternation. I could not relate to the other kids and their issues, but I did always manage to find an adult who was interested in literature with whom I could converse.

My junior high experience was a continuation of grade school. Though I was able to find outlets in the school choir and drama club, those activities were available for only small portions of the day and I remained a "problem" in many of my other academic classes. Occasionally, I was greeted in the office by my mother when she came to the school. I was generally referred to by her, as well as others, as having a "problem with authority." As a result, I began identifying with that definition of myself.

By the time I entered high school, I was just barely hanging on. I was not interested in what many of my peers were interested in--getting into a good college, buying a new car, and finding a lucrative career. I also was not interested in what the "delinquents" were doing--selling drugs, listening to heavy metal, and stealing. I felt extremely isolated and alone. Luckily, I made friends with some older kids who introduced me to some good literature. In particular, I was captivated by the writings of philosopher Henry Thoreau and poet Walt Whitman. I remember sitting in algebra class, completely tuned out of the lecture, with Whitman's *Leaves of Grass* stuck inside my textbook. At times, I would get a seat by the closed windows and stare out at the giant puffy white clouds and the bright cottonwood leaves moving with the breeze. It

seemed a cruelty beyond imagination that I should be stuck in the cold, sparse institutional rooms with only occasional chances to take a deep breath of air. Whitman wrote,

> I celebrate myself and sing myself,
> And what I assume you shall assume,
> For every atom belonging to me as
> good belongs to you.
>
> I loafe and invite my soul,
> I lean and loafe at my ease observing
> a spear of summer grass (1855/Kindle DX version, p. 18)

I longed to have the experiences that Thoreau and Whitman wrote about and to feel the way I imagined these authors experienced their simple lives in the world. What was described in their writing was so different from the consumerist pop-culture life that was all around me. The words and ideas seemed solid, permanent, and worthwhile. In *Leaves of Grass*, Whitman wrote "How curious! How real! Underfoot the divine soil, overhead the sun" (1855/Kindle DX version, p. 10). I felt a great urge inside of me to truly experience these words, and to gain the kind of wisdom I perceived from Thoreau's *Walden*:

> I went to the woods because I wished to live deliberately, to front only the essential facts of life, and see if I could not learn what it had to teach, and not, when I came to die, discover that I had not lived. I did not wish to live what was not life, living is so dear; nor did I wish to practise resignation, unless it was quite necessary. I wanted to live deep and suck out all the marrow of life, to live so sturdily and Spartan-like as to put to rout all that was not life, to cut a broad swath and shave close, to drive life into a corner, and reduce it to its lowest terms, and, if it proved to be mean, why then to get the whole and genuine meanness of it, and publish its meanness to the world; or if it were sublime, to know it by experience, and be able to give a true account of it in my next excursion. (Thoreau, 1863/Kindle DX version, p. 66)

My desire to experience the "real" life Whitman spoke of and to ensure that I did not, as Thoreau put it, "live what was not life." The idea continued to grow, nourished by the words I was reading and nurtured by my frequent walks outdoors. I felt pretty confident that I would not

be able to find what I was looking for in the halls or classrooms of Laramie High School. The tension of this dilemma came to a head one day in my English literature class. While making our way through an anthology of classic American literature, students were assigned certain readings for homework and discussion in class.

Previously, I had been one of the only class members to participate in discussion with the teacher, whether I had read the assignment or not. It was noticeable, then, when I dropped completely out of the conversations. I stopped participating because the class was reading *Huckleberry Finn* and I had skipped ahead and was reading Thoreau's 1863 work, *Life Without Principle*. After a few days of this, the teacher finally addressed me in class. He was asking me to participate and I refused, saying that I was not interested in *Huckleberry Finn*; I was interested in Thoreau. Our conversation quickly turned into an argument. I flipped to a page I had highlighted and read the quote to my teacher: "I prefer to finish my education at a different school" (Thoreau, "education," 1863).

My point was, that if a great philosopher asserted that he had received a superior education hoeing beans in the woods, then why should I be sitting there in musty classroom without fresh air or sunlight studying his words? Should I not be outside, pursuing the same kinds of experiences? On his experience at his cabin at the shore of Walden Pond, Thoreau wrote

> I did not read books the first summer; I hoed beans. Nay, I often did better than this. There were times when I could not afford to sacrifice the bloom of the present moment to any work, whether of the head or of the hands. I love a broad margin to my life. Sometimes, in a summer morning, having taken my accustomed bath, I sat in my sunny doorway from sunrise till noon, rapt in a revelry, amidst the pines and hickories and sumachs, in undisturbed solitude and stillness, while the birds sing around or flitted noiseless through the house, until by the sun falling in at my west window, or the noise of some traveller's wagon on the distant highway, I was reminded of the lapse of time. I

> grew in those seasons like corn in the night, and they were far better than any work of the hands would have been. They were not time subtracted from my life, but so much over and above my usual allowance. (1863/Kindle DX version, p. 83)

I wondered what was so special about hoeing beans, about sitting in the trees, about contemplating in nature, which might cause such a great mind to value these activities so dearly. I determined that I would be responsible to charter my own route. After some debate in class, my teacher (whom I respected very much) conceded by saying that if I thought I could give myself a better education, then it was my absolute responsibility to do so. I agreed and dropped out of high school very shortly afterwards. I was fifteen years old and free, yet with this freedom I felt much excitement and also fear. Would I really be able to accomplish my goals? Only time would tell.

For the next several years, I traveled a great deal. I wanted to see how people, other than western middle-class families and ranchers, lived. I wanted especially to meet people with very different backgrounds and to come to some understanding about poverty, hunger, and homelessness—issues that were almost completely absent in my community. I traveled all over the country and spent much of my time in National Parks and remote places. I found jobs as a motel housekeeper and a cafe waitress, here and there, to scrape by. I settled in towns that I was interested in, where I talked to homeless people and sometimes ate in the homeless shelters. I struggled with the realities of being an adult without a high school diploma and without a college education.

On one visit home, one of my former classmates tauntingly asked if I was getting a deep education from cleaning motel toilets. I thought that I was, actually. My lifestyle was a choice;

however, for many of the people I met, it was not. I saw incredible strength, perseverance, and suffering in these people. I was learning valuable lessons everyday.

Eventually I returned home, got my GED, and took some classes at the University of Wyoming. At the time, I wanted to be a midwife and I began coursework to get into nursing school. Soon enough, I found that I could not thrive in my concept of nursing school--narrow, authoritarian, and interested primarily in preserving life no matter the cost, even if the cost was a much-deteriorated quality of life. I did not want to become engulfed by this philosophy, so I left nursing school.

For some time, I ran a pizza shop with my family. I spent some time living in a Hindu ashram, or monastery. I lived on a boat in Key West and sailed on my days off. I worked in a greenhouse propagating herbs. I worked as a nursing assistant to elderly and disabled adults in nursing homes. I tried to continuously improve my mind by finding art, music, poetry, and literature to inspire and broaden my horizons. I was determined to educate myself. When I was twenty-one, I gave birth to a son, Sean. I would be raising him as a young, single mother. Working as an unskilled laborer with a small child was hard. I could not imagine what it would be like to do such work for one's whole life, and I decided I did not want to find out.

In 1997, I returned to college to study landscape architecture at Colorado State University. Studying plants, soils, the history of design, and architecture was fantastic and wonderful. I felt totally alive in that setting. I especially loved my horticulture classes when we would walk through the campus arboretum and learn to identify trees and shrubs by their bark, stem, leaf, flower, fruit, and seed. I saw all four seasons change in these plants with a fresh eye for detail and an invigorated sense of awe at the natural world.

In the Landscape Architecture program, I felt free to express myself in ways that differed from my previous educational environments. My class would get a broad assignment, such as designing a visitor's center in a forest or turning a dilapidated urban area into an exciting new neighborhood linked through plantings and greenspace. Then we were off into the studios, completely free to move around, collaborate, discuss new and audacious ideas, and to follow our creativity wherever it led. I felt completely at home; I was finally working and studying in the right environment.

My love of the natural world, coupled with new understandings about plant identification and classification, the history of gardens, and the elements of design inspired me in many ways. After two years, however, the realistic prospects of the profession became clear to me and they were not what I had envisioned. Many new landscape architects work grueling hours under more seasoned designers, designing out parking lot configurations and retaining walls for strip malls, high-end hotels, and middle class subdivisions. A few brilliant stars have the honor to design public gardens, parks, and plazas for the masses. It would likely be years of retaining wall design before I might be able to do the work I aspired to.

I wanted to design beautiful spaces for the common people of the world, who worked multiple jobs to scrape by, and for the homeless, whose only refuge from a cruel world might be a public garden. I wanted to make beautiful places for people to sit and take a deep breath, to notice the movement of the leaves in the breeze, to see children chasing after birds and squirrels, and to feel a sense of belonging in a world that sometimes seems filled with unbearable burdens. This is not what I saw in my future. With my eyes opened to the possibility my future might hold, I decided to make a bold move. I took on a twelve credit independent study to design a

series of cultural pocket gardens on the campus of Colorado State University, where I was living and studying and where I had taken a job coordinating programs for children of international students from over seventy countries around the world. There was a large population of Muslims from many countries across the Arab world and I formed many friendships. At the time, the US was bombing Bagdad, and the tension between Muslims and non-Muslims was high.

I wanted to find a way to connect landscape design with cultural understanding. I also found that I loved working with children more than I loved designing gardens. Through my independent study, I designed a process rather than just a series of gardens. My hope was to form cadres, or groups of individuals from different disciplines (such as construction management, engineering, garden design, humanities, art, and landscape architecture) on campus, who would work together to design pocket gardens that expressed a particular culture or country. My hope was, that through sharing cultural artifacts; such as Islamic tile mosaics, Arabic calligraphy, or poetry; embedded within the gardens, that the gardens could become a vehicle for cultural understanding in the community at Colorado State University. My desire for a group process became very strong and I therefore resisted from designing actual spaces, though I had many ideas of my own. Designing a process instead of the physical spaces themselves, however, was not well received by the program. I would leave the landscape architecture program and pursue the new interest of working with children.

Over the next decade, I worked with children in many settings, including after school programs, juvenile justice, and an elementary school library. In 2006, all three of my children were attending private Montessori schools, two in an early childhood program (or primary) and one in elementary. The grant for the school library had run out and I could not afford tuition for

my children. The primary program where my children attended needed an assistant, so I applied and got the job. After being around the classroom for a few weeks, I felt strongly that Montessori education was the right place for me. I wished there had been in a setting where I could move freely and make choices as a child. As an adult, I appreciated the freedom offered. Within the year, I went for my Montessori training and obtained my certification through the American Montessori Society.

I was immensely enjoying the learning that was happening all around me as well as the learning that took place within myself. Something that troubled me deeply, though, was the elite nature of the schools I had contact with—either as a parent or employee. Only the most affluent or dedicated parents sent their kids to Montessori schools, while there were scores of families desperately wanting to find alternatives to traditional education. In addition to this, as a single mother, I was working two or three jobs to make ends meet and pay tuition for my three children. I, along with several of my colleagues, talked and dreamed of a public Montessori charter school that would serve all of our children without additional financial burdens on families. Furthermore, we desired a school that was truly democratic, where each member of the staff and student body had equal say about the operation, ground rules, and other school issues that might come up. The discussions about our dream school began a five-year journey that would eventually lead to the authorization of La Tierra Montessori School, the charter that I co-founded in Española, New Mexico.

The process of obtaining a charter would prove to be long, hard, and discouraging at times. People came and went as their interest, energy and support for the project waxed and waned. At one point, I was the only person left working on the school and I decided to finish the

application for the sole purpose of satisfying my desire to finish what I started. At this point, I learned of a new trilingual Montessori school that would be opening in Algeria. I took the opportunity to meet with the organizers of the school and decided to join their team. I would finally get the chance to learn more about the Arab world and to start a school in a part of the world where--like New Mexico--choices in education were much desired.

Somehow I had found myself firmly planted in the field of education, which I had decided long ago to avoid. I did not come to education out of a desire to be in the field; in fact, I reflect that my struggles with education and the prevailing systems of organization in education for most of my life brought me here. This seems especially true in the context of authority, hierarchy, and rules. Despite my loathing of education in general, somehow I have become an educator, which seems to me more like a necessity than a choice. I have found myself unwilling to participate in systems that I find unnecessarily oppressive and hierarchical since I was a teenager. I cannot ask my children to do what I am unwilling to do, and therefore, I have spent considerable time finding educational settings for them that appear more in line with my personal values.

However, even the few private schools and other options available have their own struggles with power, authority, freedom, and the issues at the heart of my journey. I have felt that truly democratic, Earth-centered schools that are free and public may allow for equal and less discriminatory access. Because I could find no such school, I felt it was my duty to create one. La Tierra represents a culmination of the values and processes that I have sought to find for both my children and myself. My struggles as a working mother and parent have provided me with insight into how systems of education may truly support children, parents, and teachers.

My experiences with Montessori education have deeply affected my orientation to children, to learning, to my own inner journey, and to the world around me. It is through all these experiences that I have come to the work of investigating learning in living systems in Montessori environments.

Chapter 2: The status of some ecosystems on Earth

Berry wrote of the urgent need for a paradigm shift on the species level. Though the events that led to this need for a shift reach far into the past, the solutions may be discovered in the present and the future. Montessori Jr. seems to share Berry's sentiment and offered that children need a way to "see the present situation clearly and to visualize the future" (Montessori Jr., 1976/1992, p. 93). Berry goes on to offer,

> The Great Work before us, the task of moving modern industrial civilization from its present devastating influence on the Earth to a more benign mode of presence, is not a role that we have chosen. It is a role given to us, beyond any consultation with ourselves. We did not choose. We were chosen by some power beyond ourselves for this historical task. (1999, p. 7)

Maria Montessori wrote and spoke extensively about the role of humanity and its "historical task" in the larger context of the Universe. Montessori posed the questions, "What is the task of [humanity] in this wonderful Universe?" and "Do people merely live for ourselves, or is there something more to do?" (1948/2007, p. 6). Asserting that all of life was connected, and that each living organism had a responsibility to the whole, Montessori wrote, "The purpose of life is to obey the hidden command which ensures harmony among all creatures and an ever better world. We are not created only to enjoy the world, we are created in order to evolve the cosmos" (1955/1989, p. 53).

While Montessori wrote of the task of the individual in evolving the cosmos, Krishnamurti wrote about an urgent need to reform education by asserting,

> To condition the student to accept the present environment is quite obviously stupid. Unless we voluntarily bring about a radical change in education, we are directly responsible for the perpetuation of chaos and misery; and when some monstrous and brutal revolution finally comes, it will only give opportunity to another group of people to exploit and be ruthless. (1953/1981, pp. 30-31)

Berry spoke for a radical change in the way that humans interact with the present environment on Earth and within living systems. While considering Berry's suggestion of a species-level shift, I perceived that opportunities for moving towards such a shift might be welcome in the classroom. In order to present examples of environmental challenges that support Berry's sense of urgency, I have no need to go back any further than headlines present at the beginning of my journey with the TIES program in January 2011.

Environmental Challenges

There are numerous examples of the challenges that humanity now faces in the living systems of the Earth that support Berry's premise for the need of a shift in humanity. In 2011 alone, technological and natural disasters had devastating effects on humans and the planet. Some suggest a need for more effective responses to these crises (Webb, 2010; Carol, 2011).

Figure 2. Second Explosion at Fukushima nuclear plant (NKH, 2011).

Human response to events such as the crisis at the nuclear power plant ("Japan: a year," 2012) and the BP oil spill in the Gulf of Mexico (Webb, 2010) appear to raise questions about corporate and governmental response to environmental crises.

Figure 3. "A brown pelican is seen on the beach at East Grand Terre Island along the Louisiana coast on Thursday, July 3rd, 2010" (Riedell, 2010).

Could an evaluation of the cost to global life systems resulting from nuclear and oil-related accidents as well as an evaluation of the global environmental costs of resource consumption provide some insight to these questions? Scientists on the Intergovernmental Panel of Climate Change claim evidence that human-produced conditions--specifically increasing carbon emissions--have the result of a global rise in temperature, known commonly as global warming (Hanson, et. al., 2005, "Climate Change," 2007). Predictions are that the global temperature may rise between 2 and 6 degrees Fahrenheit by the end of the 21st century, even if carbon emissions are reduced (Riebeek, 2010). An overall rise of a degree or two Fahrenheit may have a devastating effect in regions such as the Horn of Africa, which has historically struggled with the consequences of drought, desertification, and famine.

In 2011, Somalia and Ethiopia were experiencing the worst drought and famine in sixty years. This drought, which was predicted by global warming experts, has affected more than 12 million people (Flood, 2011).

Floods in Pakistan displaced over 200,000 people ("Pakistan floods..." 2011) and in Thailand, flooding affected more than two million people ("Government says floods..," 2011). Possible increases in natural disasters worldwide, including flooding, earthquakes, tsunamis, and melting ice caps have been attributed by some scientists as symptoms of global warming (Riebeek, 2010, Kluger, 2006).

Meanwhile, ice caps and glaciers at the poles and in the mountainous regions continue to shrink and break off, which have been connected to human-induced global warming (Kluger, 2006). Habitats continue to be destroyed by corporations that focus on obtaining resources primarily for profit. (Bryan, 2011, Mongabay, 2009). The NASA Earth Observatory web feature "Global Warming" includes the following description:

> The impact of global warming is far greater than just increasing temperatures. Warming modifies rainfall patterns, amplifies coastal erosion, lengthens the growing season in some regions, melts ice caps and glaciers, and alters the ranges of some infectious diseases. Some of these changes are already occurring. (Riebeek, 2010)

Looking back at the headlines, it may be clear that there are numerous challenges to the environment, which may signal a time for rethinking relations with the natural world. From the BP oil spill to the Fukushima nuclear disaster, to the long term effects of climate change such as floods, drought, and ice melts, worldwide instances of environmental crises could be becoming large enough to seriously threaten life on Earth. A myriad of environmental challenges face humanity, as well as numerous social challenges inherent in such a shifting state of the world.

Social Challenges

Social challenges have been prominent in headlines in news programs around the globe in 2011 and 2012 and appear to have common threads globally. For example, the use of social media for spontaneous networking and coordination of efforts between various organizations appear to be spurring governmental change in the U.S., Egypt, and Europe (Fleming, 2011; Hider 2012; Ngak, 2011; BBC, 2011). Could the globalization of human culture and technology such as Facebook, Twitter, and YouTube be used to unify social struggles and challenges around the globe?

Common social challenges include poverty, resource distribution, political challenges, religious and ideological tension, and unsustainable consumerism, as well as lack of connection to place, culture, and meaning. I perceive that the ever-widening gap between the wealthy and the poor seems to be highly placed among social challenges, as demonstrated by the Occupy Movement, the European riots, and the Arab uprisings. According to the 2007 United Nations Development Program's Human Development Report, out of 2.2 billion children in the world, 1 billion were living in poverty (UNDP, 2009).

In the US and around the world, the Occupy Movement, which began as "Occupy Wall Street" to protest corporate greed, gained tremendous momentum with the slogan, "We are the 99%." The 99% slogan was intended to illustrate the social and economic divide between the wealthiest 1% percent of Americans and the rest of society. While the Occupy movement developed in cities around the US, others in Europe and around the world set up Occupy camps as well (Fleming, 2011).

Figure 4. "Occupy Wall Street protesters fill Zucotti Park in New York's financial district on October 5" (Freeman, 2011).

Rioting in Europe over worsening economic and social concerns regarding resources and their distribution, politics and civic engagement (BBC, 2011) as well as the political revolutions of Egypt, Tunisia and Libya--commonly referred to as the "Arab Spring"--further point to social issues such as housing, unemployment, rising food prices and unchecked government power that seem to be globally connected (Peterson, 2011).

Figure 5. Protesters gather in Tahrir Square, Cairo (Abed, 2011).

Large numbers of citizens in the streets of New York, Greece, and London present similar scenes on every continent that suggests a commonality of struggles--the social problems New Yorkers face appear to be similar to the social concerns raised in the 2011 Tahrir Square

demonstrations. There is support for the idea that these social movements are connected, especially through globally social networks such as Facebook, Twitter, and YouTube (Ngak, 2011; Hider, 2012). It may be that individuals living in distant lands, though facing similar social issues, have found a way to connect and amplify their voices. Could large numbers of demonstrators in streets and squares around the globe, asking for similar reforms, suggest that the time may be ripe for a collective global shift for humanity? How are the social and political movements connected with physical and mental health?

Physical and Mental Health Challenges

In addition to the environmental and social issues outlined above, many people are concerned about challenges regarding physical and mental health. One must wonder why, for the general American population, the number of prescriptions for anti-depressants doubled between 1995 and 2005-about ten percent of the population (Szabo, 2009). Are the psychological challenges facing humanity related to the environmental, social, and economic issues? Berry felt that they were related, writing that in children we "see additional stresses, emotional disruptions, and learning disabilities that seem to originate in the toxic environment and processed food that we provide for them (1999, pp. 15-16). A 2012 report from the American Public Health Association also found a 137% increase in adult obesity, with a rise from 11.6% in 1990 to 27.5% in 2011. The report also shows a dramatic increase in adult diabetes, with new diagnoses nearly doubling from 4.4% in 1996 to 8.7% in 2011 (APHA, 2012). Georges C. Benjamin, M.D., executive director of the Association offered that "Addressing the leading causes of these largely preventable diseases is essential if we are going to improve the nation's health," (APHA, 2012). The International Diabetes Foundation reported a 7.2% adult diabetes rate in Algeria in 2007

(IDF, 2008). Could the rise in diabetes, obesity, and mental health issues be related to a rise in consumer culture, which promotes a disconnection from the natural world and other humans? Is humanity compromising the quality of life for its own species?

Figure 6. "Mihag Gedi Farah, a malnourished seven-month-old child weighing only 7.5 pounds (3.4 kg.), is held by his mother in a field hospital of the International Rescue Committee, IRC, in the town of Dadaab, Kenya, on July 26, 2011 (van Zuydam, 2011).

One challenge I perceive for those seriously contemplating environmental concerns and disasters might be the perception that disasters such as famine, oil spills, and nuclear disaster, only happen to people far away. Many seem aware of specific issues in local communities and may have a hard time making the connections between their communities and others in different regions of the globe. An ordinary New Mexican may have a hard time imagining living through the famine in the Horn of Africa, but they probably are familiar with the recent drought conditions in New Mexico and the related crises to that drought. Being well informed about one's own community and its challenges may facilitate understanding about the challenges of other communities. For this reason, I have explored specific environmental issues in the area around Española, New Mexico and Algiers, Algeria, looking for connections between these seemingly unconnected communities.

Specific environmental challenges in Northern New Mexico

To some New Mexicans, the drought in Somalia may seem irrelevant, however, the local drought may be more apparent. Most local residents have seen news reports about issues at Los Alamos National Laboratories, the drought-induced piñon tree dieoff, and the largest wildfires in New Mexico history that have happened over the last two years. Do local New Mexicans connect these issues to global warming?

Northern New Mexico may be most well known for being the home of Los Alamos National Labs (LANL), dubbed in a Reuters article as "the linchpin of the American nuclear weapons industry" (Carroll, 2011), where the atomic bombs dropped on Hiroshima and Nagasaki at the end of World War II were assembled. Los Alamos sits on a high plateau about twenty miles to the southeast of Española, with the pueblos of Santa Clara and San Ildefonso located downhill along the Rio Grande River.

Within the vast expanse of lab property of some forty square miles, there are unknown thousands – perhaps hundreds of thousands--of barrels of radioactive waste buried. Not all of the waste burial sites have been located and many of the substances buried are of unknown origin. Some of the waste has seeped through the layers of rock and down into the nearby canyons and the Rio Grande. In response to an extensive 2002 New Mexico Environment Department report on the contamination, LANL agreed to clean up contaminated soil at over 2,000 sites (Clifford, 2009).

In the Los Angeles Times article, *Toxic Waste Trickles Towards New Mexico Water Sources*, Clifford states that an area of particular concern to scientists is groundwater contamination and that this issue is not addressed in LANL's cleanup agreement (2009). One of

the canyons contaminated with radioactive waste is three miles north of a major water diversion project under construction that will pump three billion gallons of water annually to the city of Santa Fe. LANL maintains that there are no serious health risks. However, Ron Curry, secretary of the New Mexico Environment Department told the Los Angeles Times, "When you see a child's footprints and Tonka toys in canyons where there is plutonium, there is reason to believe that a lot more work needs to be done to make the environment safe" (as cited by Clifford, 2009).

In the summer of 2011, as I entered the second semester of the TIES program, my friend Roger Montoya and I were putting the finishing touches on our charter school application as we watched the hills burn to the west in the Los Conchas fire. The Los Conchas wildfire scorched more than 150,000 acres of land, including areas in and around the Los Alamos National Labs. Local pueblo sacred sites were threatened and my family was evacuated twice due to dangerous levels of smoke. On July 1st, 2011, Montoya and I drove from Velarde, New Mexico to Albuquerque--about ninety miles--to drop the charter application off for La Tierra Montessori School of the Arts and Sciences. We watched in anguish and disbelief at the line of fire and smoke that accompanied us on the ridges to the west for the entire drive. The scope of the fire was devastating. The continuing drought produced conditions that led to an even bigger wildfire in 2012, the Whitewater Baldy wildfire, which burned 190,000 acres, or 300 square miles (Contreras, 2012).

Media reports cited concerns about the Los Conchas fire and its proximity to Los Alamos National Lab's LANL's underground storage of toxic waste. In an effort to reduce toxic residue from being swept by potential flooding into the Rio Grande, LANL removed 1,200 cubic yards

of contaminated soil in two days. Meanwhile, the LANL assured the public that cleanup is not necessary at contaminated sites ("Contaminated soil at...," 2011).

Figure 7. "Cattails in a contaminated LANL wetland" ("Yes, there are radioactive...", 1999).

The Los Alamos Study Group, a local watchdog organization, took Geiger readings in 1999 of plants, anthills, and other locations in unfenced canyons within the Los Alamos boundaries. This clump of cattails shows a Geiger reading that is about ten times higher than normal levels of background radiation ("Yes, there are radioactive," 1999). The Los Alamos National Lab properties are considered part of the local environment and bioregion of La Tierra Montessori School.

Changes in population and agricultural practices in the region also affect the environment of northern New Mexico in regards to land use, agriculture, and water quality. In 2007, six scientists at the New Mexico State University field office published a study of land use and water quality issues over a forty-year period in the Alcalde Range of Northern New Mexico, an area just north of Española, which includes the property where La Tierra Montessori School is located. Authors of the study used GIS mapping techniques to plot land use data from 1962,

1997, and 2003 (Ortiz, Brown, Fernald, Baker, Creel & Gulden, 2007). Categories of land use included: orchard, row crop, fallow, pasture, riparian, and residential use.

Based on the land use categories, the results of data analysis showed that significant changes occurred: Acreage dedicated to orchards dropped by 67%, and row crop acreage dropped by 53%; pasture land (for raising sheep and cattle) grew by 47% and residential acreage grew by 553% (Ortiz et al, 2007). The authors of this study cited concerns about the huge jump in residential acreage and on-site septic systems as potential hazards to the water quality of local aquifers (Ortiz et al, 2007). The study also acknowledged an impact on the cultural acequia practices and overall connection to cultural traditions in the area (Ortiz et al, 2007). Could severe loss of agricultural land, coupled with a huge increase in residential properties in rural Northern New Mexico be contributing to the loss of cultural practices in the area and a disconnection from the land itself?

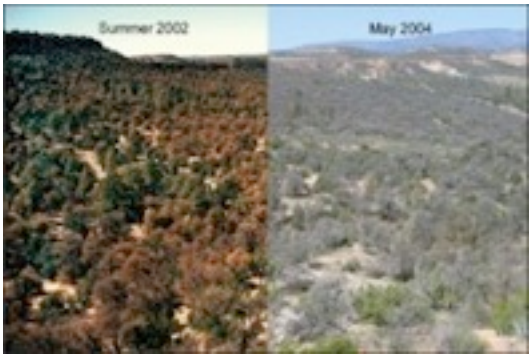


Figure 8. "The forest around Los Alamos before and after drought stress and a bark beetle outbreak" (Allen, 2009).

Another specific environmental concern in the local bioregion is the piñon bark beetle plague. The piñon tree is the state tree of New Mexico. The piñon harvest, roadside sales, and

traditional New Mexican foods made with piñon are celebrated traditions for many New Mexicans around Española. Much of northern New Mexico has been in severe drought conditions since 1996 leading to weakened piñon forests, an explosion of the piñon bark beetle population and a massive die-off of piñon trees throughout Northern New Mexico (Allen, 2009).

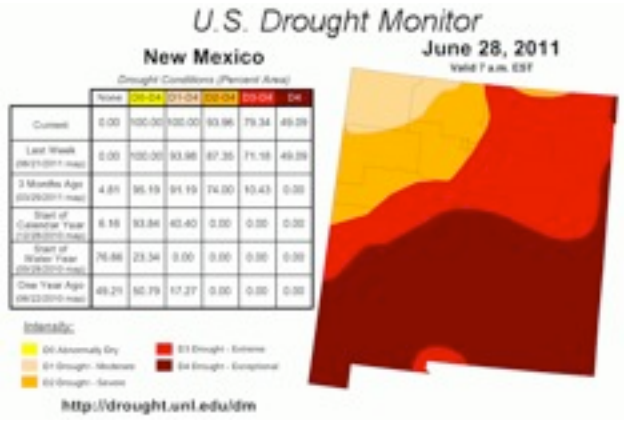


Figure 9. U.S. Drought Monitor Map-Light orange areas denote moderate drought, dark orange denote severe, red denotes extreme, dark red denotes exceptional (Helm, 2011).

Conditions related to the drought and subsequent piñon die-off include watershed runoff, toxic soil contamination, and soil erosion. An estimate of fifty-five million trees have died in New Mexico in the last seven years, or roughly ten percent of the state's piñon population (Santa Fe trees, 2012).

The safety issues regarding contaminated soil, water, and plants around the Los Alamos National Lab, along with changes in land use, watershed concerns, and piñon forest die-off are a few of the challenges in the immediate area around La Tierra Montessori School. I have experienced these issues directly affecting students and families in the bioregion. May an exploration of these issues in local schools foster a deeper understanding of the local bioregion?

How can this understanding be expanded to include other environments in locations as far away as North Africa?

Specific environmental concerns in Algiers, Algeria

Algeria is the largest country in Africa since the division of Sudan into Sudan and South Sudan. The country is situated on the southern side of the Mediterranean Sea between Morocco and Tunisia. The capital city of Algiers is located in the fertile strip that lines the coastal area. The majority of Algerians live in this region, while a much smaller population of native Berber and Tuareg people inhabit the vast desert regions of the country.

Drought and desertification are major environmental issues in Algeria and all of Africa. A 2007 United Nations Economic and Social Council report outlines results of desertification having "far reaching adverse impacts on human health, food security, economic activity, physical infrastructure, natural resources and the environment, and national and global security" (UNESC, 2007).

In 2006, Algiers hosted the United Nations Environment Program's (UNEP) annual celebration of World Environment Day. The theme for the year was "Deserts and Desertification." Algeria contains the largest portion of the Sahara desert, which stretches from Morocco to Egypt, and has good cause for worries about desertification. The American Heritage Science Dictionary defines desertification as "The transformation of land once suitable for agriculture into desert. Desertification can result from climate change or from human practices such as deforestation and overgrazing" ("desertification," n.d.). This phenomena phenomenon is a concern to all of the North African countries including Morocco, Algeria, Tunisia, Libya, and

Egypt in the north and Mauritania, Mali, Niger, Chad, and Sudan in the south. At the conference, UNEP Executive Director Klaus Toepfer said,

> Land is – next to water and air – the very base of all life. But unlike air and water, which can be cleaned up and rehabilitated, once soils are lost it can take millennia for nature to recreate them. Human-induced land degradation now affects all continents and needs to be addressed urgently. It is appropriate that attention should focus on North Africa when we speak of the devastating effects of desertification. (as cited by Falt, "Human-induced," 2006).

Figure 10. UNEP Drought Map 1996-2006. Light green areas denote 1-2 drought events, light yellow denotes 3-5 events, orange denotes 6-9 events, and red denotes more than 10 drought events in ten year period (UNEP 2007).

Could Toepfer's words about the threat of desertification to all continents, coupled with the devastating loss of forest, fires, and soil erosion connect concerns about desertification to the students of New Mexico? If New Mexico students were concerned about this issue in their own communities, might they also be concerned about it in other communities and even on a global scale? If these connections were made, how might those concerns be demonstrated as students become adults and take on the responsibilities of purchasing and caring for land? How may individuals, educated in basic ecological principles, respond to a developing drought situation halfway across the globe?

Somalia and Ethiopia, located in the Horn of Africa, have experienced severe drought in the last twenty-six years, as illustrated by the map above (UNEP, 2006). According to the map, Countries in red have experienced ten or more drought events from 1990 to 2006. Algeria experienced three to five drought events in twenty-five years. According to United Nations Secretary General Koffi Anan, people living in dryland regions, are susceptible to risks:

> Drylands… are found in all regions, cover more than 40 percent of the Earth and are home to nearly 2 billion people – one-third of the world's population. For most dryland dwellers, life is hard and the future often precarious. They live on the ecological, economic and social margins. It is essential that we do not neglect them or the fragile habitats on which they depend. (as cited by Falt, "Human-induced," 2006)

Further information about the environment in Algeria from the UNEP study includes: Algerian soils are further depleted by overgrazing and poor agricultural practices; the Mediterranean Sea suffers pollution from the oil industry, sewage dumping, and dynamite fishing practices; water in Algeria is scarce and questionable for potability (UNEP, 2006). Especially in the Sahara, water is scarce.

The contrast between water use and other resources in the US and Algeria can be illustrated using the Population Reference Bureau's 2000 Fact Sheet, which compares my home state of Wyoming with Algeria these two countries. According to the Fact Sheet, the average daily water use per capita for personal use in Algeria is around five gallons a day, representing 25% of total per capita water use, totaling 130 gallons. In the state of Wyoming, the personal daily water use is about 147 gallons, which represents one percent of total daily water use per capita, or 14,700 gallons. Wetland loss in Wyoming was 38% in 2000 . In Algeria, the average per capita oil use was the equivalent of 7.9 barrels of crude oil, with one motor vehicle

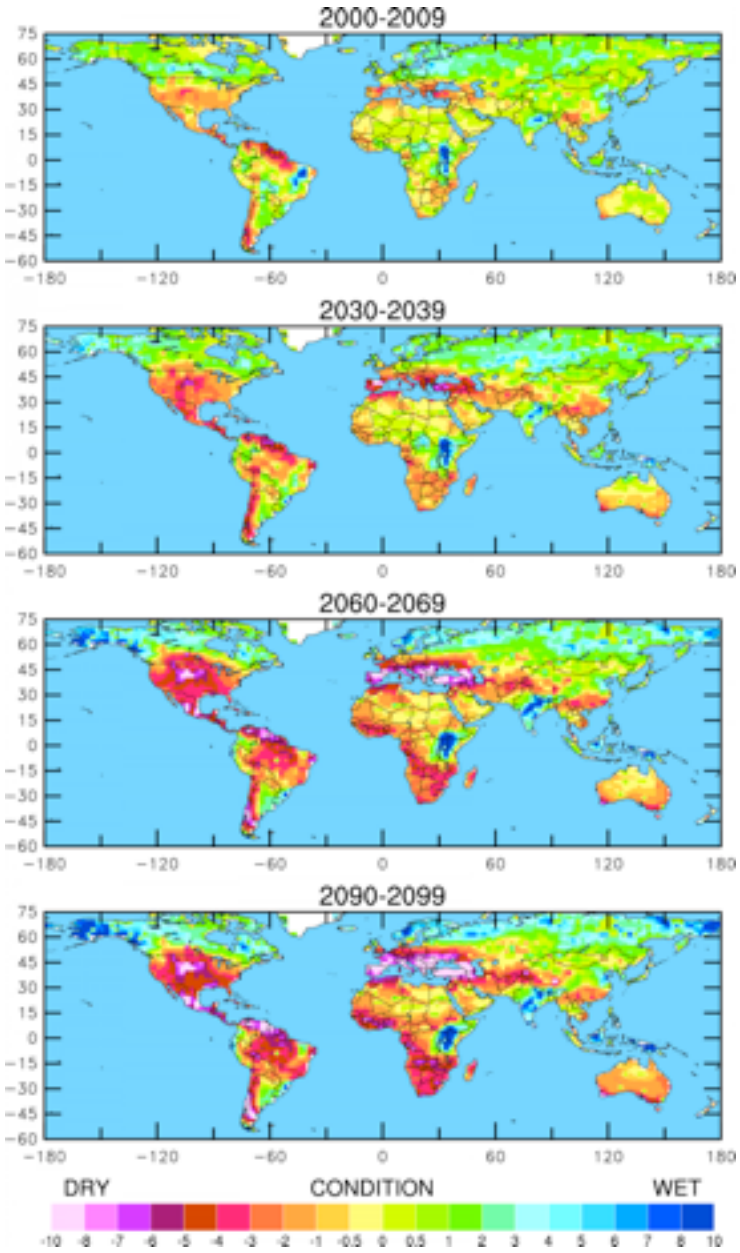


Figure 11. "Future Drought.The maps use a common measure, the Palmer Drought Severity Index, which assigns positive numbers when conditions are unusually wet for a particular region, and negative numbers when conditions are unusually dry. A reading of -4 or below is considered extreme drought. Regions that are blue or green will likely be at lower risk of drought, while those in the red and purple spectrum could face more unusually extreme drought conditions. (UCAS, 2012).

or every nineteen people. In Wyoming, the average annual per capita oil use was 153.8 barrels of crude oil, with one motor vehicle for every 0.9 people (PRB, 2000).

While desertification and related issues are important in Algeria, perhaps the most visibly present environmental challenge for Algeria is pollution of the environment with trash. I personally witnessed major issues with sanitation. Trash litters the streets, rivers, and countryside in copious and shocking volumes. Algiers ranks 185 out of 221 cities in the Middle East and Africa for sanitation and the worst (ranked number 221) was Baghdad, the capital of Iraq. (*"2011 Quality of.,"* 2011). It is hard to gain an understanding of what the sanitation issue means for the environment, and for the humans living in that environment, without being present in it. I spoke with representatives of UNICEF and others about trash in Algeria (personal communication, 2012) and the topic appears to be taboo in Algeria, and "off the table" in terms of strategizing for non-governmental organizations working in the country, such as UNICEF Algiers.

Trash is not the only form of pollution that is a major concern in Algeria. Though rich in oil reserves, the country lacks infrastructure and regulation to properly maintain the industry, and I witnessed widespread pollution of the waters and soil. Severe housing shortages resulted in government-led housing projects, which eat away at the many small farms that produce the fruits, vegetables, and grains that Algerians depend on for food. Food security and quality are issues that most Algerian families face, and in my experience, I saw many families depend on staples like bread and couscous for the bulk of their sustenance. In addition to this, Algeria seems to be continuously facing the threat of severe drought and desertification.

Many of the environmental issues that affect Algerians are strikingly similar to the issues that people in Northern New Mexico face. Though they may not be aware of each other or the specific challenges presented in these two communities, I have experienced that many common threads exists, though the PRB Fact Sheet can be viewed as an illustration of how distribution of resources might affect communities and environments on the other side of the globe. Both fresh water and oil are limited resources on our planet. I also suggest that these types of connections may be seen to exist around the globe. Perhaps the most visible of these connections is the common and growing issue of drought. Most people understand the possibility that this drought is part of a larger systemic issue, which all of our communities might be facing in the near future, and refer to the issue as "anthropogenic climate change" (IPCC, 2007). The following model, developed by the University Corporation for Atmospheric Science, show potential conditions for drought based on predictions of greenhouse gas emissions. The models were developed using the Palmer Drought Severity Index (UCAS, 2012).

If this model accurately predicts the future, it may be that the masses captured in the media flocking to camps in Somalia in 2011 could bear some resemblance to the masses that fill camps in Española and Algiers in the future. Perhaps Berry's idea of "species-level shift" may occur whether we acknowledge the idea or not. Is humanity ready for this shift? How does consumption and distribution of resources support a shift towards a healthy planet?

Consumerism and the Environment

The term consumerism, for the purpose of this paper, is defined as "a preoccupation with and an inclination toward the buying of consumer goods" (Merriam-Webster, 2010). In seeking consumer goods as a means for happiness, consumers may unknowingly contribute to the

degradation of the natural world, which in turn may lead to further disconnection from their ecological roots.

Psychotherapist and complexity thinker Humberto Mariotti offered that human culture is responsible for creating a context where consumerism overtakes natural patterns as characteristics of living systems and that "marketing and other means of mass conditioning try (and in many cases succeed) to do with entire populations" ("Autopoiesis," n.d.). He suggests a culture of "mass-production of subdued people" through "widespread and constant" conditioning (Mariotti, "Autopoiesis," n.d.). The result, Mariotti continues, is "the consolidation and continuing operation of violence against the most basic of the characteristics of living systems" ("Autopoiesis," n.d.). In fact, Mariotti suggests that only humans utilize competition and predatory practices, which ultimately lead to "wars, genocide, social exclusion and other forms of violence" ("Autopoiesis," n.d.).

To illustrate the difference between human society and the natural world, Maturana gives the example of

> when two animals meet before the same piece of food and only one eats, this happens because *in that specific moment* one of them was the most competent to do so. But this does not mean that the animal that was unable to eat is doomed to be, from that moment on, forever forbidden to eat until death arrives. This does not happen in nature. (Maturana, as cited by Mariotti, "Autopoiesis," n.d.)

In the oral presentation of my work at TIES, I used the example of the African savanna because of the common perception many people have that "Africa" is a savanna. Algeria does not actually contain any savannas regions. The savanna is the type of a place where a lion and a hyena might both spy a stray gazelle they wish to kill for food. In any given situation, either the lion or the hyena might be more competent in the moment to get the gazelle. If the hyena is with

a pack, it may have a better chance, or, if alone, the lion might be the most competent. As this scenario unfolds, one or the other, or neither, will have a gazelle to eat. The "winner," however, is not guaranteed to always get the kill and the "loser" will likely find other food. The roles could be switched on another day and in a different set of circumstances. Regardless, there is no animosity per se between the animals, as each one is merely attempting to meet individual needs for survival. Mariotti stated that the relations between humans are different, however, and that the most competent person in a given situation will

> make sure that the one who was not able to eat must cease forever to be a threat. In other words, competitive men usually do not feel sure of their competence, so they have the need to get rid of whoever could jeopardize them. In other words, when men cannot trust in themselves as living beings, their peers must be eliminated as soon as possible. (Mariotti, "Autopoiesis," n.d.)

A competitive and predatory orientation, Mariotti suggested, belongs to humans exclusively and may be considered one of the characteristics of what he called "linear thinking" that "leads us to value things in an excessive way and then to depreciate ourselves and, by extension, do deny the humanity of our peers" ("Autopoiesis," n.d.). Mariotti further suggested that an overemphasis on money exacerbates social exclusion, contempt for others, and the view that other human life is disposable--ideas which led him to conclude that human culture is, in fact, a living system, but one that is pathogenic ("Autopoiesis," n.d.).

To Mariotti, consumerist training produces individuals "who alienate themselves to the things of the world" and "deny the humanity of our peers" ("Autopoiesis," n.d.). Perhaps this alienation may provide some insight into explaining how the famine in the Horn of Africa might have been disregarded despite the advance knowledge of the crisis. If humans are disposable

goods, in a world of competition and predation, then there must be winners and losers. If Mariotti's suggestion regarding human pathologic predation is accepted, then it also follows that the loser--in this particular case, Somalians and Ethiopians--are "doomed to be, from that moment on, forever forbidden to eat until death arrives" and that this scenario is acceptable in terms of human culture and societal values ("Autopoiesis," n.d.).

In revisiting the question, "Do we merely live here for ourselves, or is there something more?" the answer, as described by Mariotti, may be "yes" in terms of modern consumer culture as it operates at all levels of society. Defining human cultural values, rethinking consumption, and reconnecting with other living systems may be useful in aligning humanity to the living systems of the Earth. The concerns associated with a humanity deprived of natural resources may call for the values of consumer culture to be questioned.

Montessori offered that "Evidently the social conditions produced by our civilization create obstacles for the normal development of man" (1955/1989, p. 10). These words were obviously written without knowledge of modern-day environmental and social conditions. It may be hard to imagine what she might say about the social conditions of the world today. Taking in all these recent examples of environmental, social, and health issues that face humanity today, is it possible to support global shifts in the human approach to living systems on Earth?

It may be reasonable to say that the current environment on the planet is a cause for concern. The communities of Española, New Mexico and Algiers, Algeria are two examples of specific environments on opposite sides of the globe, both of which face strikingly similar environmental, social, and health concerns. How are children being supported in these

communities to face these challenges? The specific environments of children in these communities is may be useful to explore and may provide insight into what support might be needed to deal with the environmental, social, and psychological challenges in the future.

Chapter 3: The present environment of the child

Chapter Two explored some examples of the present circumstances that face humanity today on the Earth. While it is certainly plausible that actions can be taken immediately to address some of these challenges, particularly through environmental policy, governmental legislation, and social reform, the search for long-term solutions will likely be handed down to the children of today's world. Are today's children receiving the support and tools to find these solutions?

It may be useful to promote the development of creative, complex thinkers, who can look at issues from multiple perspectives, and see the connections between seemingly disparate issues. The goal may be to provide the conditions for nurturing intelligence in children. Krishnamurti (1953) offered that

> Intelligence is not mere information; it is not derived from books, nor does it consist of clever self-defensive responses and aggressive assertions… Intelligence is the capacity to perceive the essential, the what is, and to awaken this capacity, in oneself and in others, is education. (p. 14)

Are the environments for today's children supporting the capacity to perceive Krishnamurti's idea of "what is?" In looking at this question, I have placed particular emphasis on the children around Española, New Mexico and the children around Algiers, Algeria. As with the issues explored in Chapter Two, I perceive that there are similar circumstances for children in

these two communities. A focus on consumerism might be the strongest commonality these children have.

Consumerism in Children

Mariotti wrote about consumerism overtaking natural patterns as characteristics of living systems and that consumer culture is spreading throughout society. This assertion presumably includes children being indoctrinated into educational systems. Along with Mariotti, Berry appeared to have concerns about children's experiences with the characteristics of living systems. Berry wrote,

> For children to live only in contact with concrete and steel and wires and wheels and machines and computers and plastics, to seldom experience any primordial reality or even to see the stars at night, is a soul deprivation that diminishes the deepest of their human experiences. (1996, p. 82)

According to ecological models, each human is a part of the living system of the natural world. Yet, it may be increasingly observed that children are less connected to the natural world than their predecessors. In the *Hidden Heart of the Cosmos*, cosmologist Brian Swimme suggested that humans trade the "living universe for cheap toys and gadgets" (1996, p. 46). He added that the "advertisement is our culture's primary vehicle for providing our children with their personal cosmologies" and that the ideal person is one who enjoys life "unencumbered by powerful ideas concerning the nature of goodness" (Swimme, 1996, p. 17). The human tendency to align with messages that are reinforced in society at large, as Mariotti suggested, may be especially strong in children.

According to Swimme, children are the target audience of many products and view an average of thirty thousand advertisements for products each year (1996, p. 13). Swimme

describes the desire to own the latest toys, games, and fashion styles "based upon dissatisfaction and craving," which may be directly connected to self-esteem and a lack of sense of belonging stimulated by the advertiser's power to "promulgate a world view" (1996, p. 16).

Swimme suggested that "the cave has been replaced with the television room and the chant with the advertisement" (1996, p. 13), heralding a switch from the transmission of sacred stories and culture from family and community members to corporate advertisers who do not have the best interests of children in mind. Swimme called consumerism "the new global religion," and advertising messages "the new Cosmology" (1996, pp. 13-17).

If consumerism is, indeed, the new global religion and if children are trained in their 'television rooms' to assimilate modern culture primarily by consuming advertised products, then perhaps the basic values of modern culture should be questioned. While wearing the latest fashions might make a big impact on a child's social status, displaying care for the natural world may not produce visible social rewards for children. The general atmosphere of consumer values appears to present particular challenges for parents wishing to raise children who contribute to a species level change towards Earth orientation. How would cultural values shift if children learned that caring for the natural world had social rewards?

In addition to lack of connection to the natural world, Montessori wrote about the impact of common social values on the development of the intellect and offered grave warning:

> A mind that is habituated to seek pleasure only in fantastic tales slowly but surely becomes lazy, incapable of nobler preoccupations. In social life we find too many examples of this sloth of mind, people caring only to be well-dressed, gossip with friends and go to the cinema. Their intelligence is hopelessly buried under barriers which cannot now be removed. Their interest becomes increasingly narrow, till it is centered round the

> petty self, excluding the wonders of the world and sympathy with suffering humanity. Theirs is a veritable death in life. (1948/2007, p. 11)

One might wonder about what kinds of experiences might prevent an obsessive preoccupation with fantasy, the consumption of material goods, and the tendency to see other humans and life forms as disposable objects. May observing and interacting in the natural order, as opposed to consumer order, ease the consumer driven diminishment of children's souls? Might learning in living systems offer conditions for the development of intelligence without the barriers Montessori wrote about? Could modern intelligence be grounded in the beauty of the living world, rather than the beauty of objects collected for the self? If childhood intelligence is diminished by a lack of contact with nature, are there other areas of health that may also be compromised?

Nature Deficit Disorder and Special Needs Children

Parents today are increasingly worried about childhood health issues, including nature-deficit disorder (NDD), attention deficit hyperactivity disorder (ADHD), and autism. In 2005, Richard Louv authored the book *Last Child in the Woods*, which sparked concern over the newly coined term "Nature-Deficit-Disorder." Louv asserted that children are spending less and less time outdoors, resulting in behavioral problems, such as ADHD (Burak, 2012). Louv also suggested that outdoor time is limited by children's addiction to screens (television, computer, and game players), by unrealistic parental fears about strangers and health hazards, and by shrinking access to the natural world (Burak, 2012). Many naturalistic areas and interpretive trails today are designed to restrict movement and prevent children from free exploration, touching, and experiencing nature even in the outdoors. While efforts to preserve natural areas

may be well meaning, Louv suggested that those restrictions "criminalize" normal childhood play in outdoor environments (2005, pp. 27-31).

The popular book has sparked debate about control of natural areas, parental fears, and children's relationships with nature. NDD has not been recognized or incorporated into the standard psychological diagnostic guide, the Diagnostic and Statistical Manual of Mental Disorders IV (or DSM-IV). However, the concepts behind Nature Deficit Disorder may offer opportunities for reflection regarding the outdoors and children's health. Proponents of outdoor learning suggest that learning in natural environments aids in physical development, social development, and psychological regulation, especially for kids diagnosed with disorders like ADHD (Burak, 2012). Researchers at the University of Illinois found that students with ADHD were able to focus better after spending time outdoors, and that "the greener a child's everyday environment, the more manageable their ADD symptoms" (Faber, Kuo, Sullivan, as cited by Sachs & Vincenta, 2011, p. 1).

As of 2007, according to the US Centers for Disease Control, parents reported that 9.5% of children aged 4-17 have been diagnosed with ADHD, with diagnoses increasing 5.5% a year from 2003 to 2007 (CDC, 2011). The CDC's state-based prevalence map shows the rates of ADHD lowest in western rural states, with prevalence rising to highest levels along the Eastern seaboard, where population density is much higher. Could a lack of access to outdoor environments in densely populated areas affect the increase in ADHD diagnoses?

Another concern for many parents is the rise in Autism Spectrum diagnoses. Rates of Autism diagnoses in US children have risen to 0.74% between 2006-2008 up from about 0.19% between 1997-1999 (CDC, 2011). Landscape architects Naomi Sachs and Tara Vincente

specialize in designing outdoor learning environments for children with special needs, including autism. In the publication *Outdoor Environments for Children with Autism and Special Needs,* the authors relate, "Many children with autism are in highly structured indoor learning environments during their day and may receive great benefits from having meaningful experiences outdoors" (Sachs, Vincente, 2011, p. 1). Sachs and Vicente include considerations for autistic children's needs in designed landscapes, including sensory nests, visual screens, predictable patterns, and visual maps. If statistics and research findings related to ADD, Autism, and other childhood disorders are linked to Louv's NDD, then supporting ample opportunity for learning in living systems may help with these disorders.

Are outdoor environments available to children today? What are the specific environmental conditions that children are exposed to? What are the characteristics of children's environments in New Mexico and Algeria? Are there common threads and connections between these environments?

Environments for Children in New Mexico

In the Española New Mexico school district, where La Tierra Montessori School is located, approximately 58% of high school students graduate (NMPED, 2008). The district reported an average reading proficiency rate of 39.6% for students in grades K-6 and 38.1% for middle school students in the 2009-2010 school year. Math proficiency in the district averaged 36.8% for K-6 students and 17% for middle school students (NMPED, 2010). These statistics clearly show large percentages of children are not developing the capacities for basic academic skill acquisition. Could the environments in schools and the delivery of educational programs be related?

One way to support children's learning is through providing healthy foods. La Tierra Co-founder Roger Montoya and I distributed the "*Española School Choice Survey"* (ESCS) to gain understanding of local parents' priorities for their children's education. In the survey results, a desire for "healthy lunches and food" ranked second in a list of twenty-four items. Despite low proficiency in reading and math, the desire for healthy school lunches outstripped both as a priority for parents.

Poverty, food security, and other domestic issues affect many children of Española. According to the 2010 US Census, 20.1% of Rio Arriba County, New Mexico's residents under eighteen years old live in poverty ("Selected economic characteristics," 2011). Thirteen percent of New Mexico's Hispanic youth reported not having enough food to eat in 2005 (Green, Peñaloza, & Blair, 2010).

A recent article published by the Berkeley, California non-profit Center for Ecoliteracy outlined some of the challenges to food security in semi-rural areas of New Mexico. Janet Page-Reeves, anthropologist at the University of New Mexico's Prevention Research Center explained, "The population is very dispersed, and you have to drive far to get to a retail store... the average resident travels 29 minutes each way to a grocery store, many of which are convenience stores with little or no refrigeration-and higher prices than stores in larger cities" ("Dispatch from New," 2012).

While food security is a major issue for New Mexican children, the quality of food can also be seen as a concern. Children growing up on a diet of convenience store food, school lunches, and McDonald's are eating lower quality foods that are high in fat, sugar, and carbohydrates and low in quality fresh fruits and vegetables. Poor eating habits have been

proven to lead to obesity and diabetes. Currently, 32.7% of New Mexico's children are obese, and at risk for Type II diabetes (Clayton, 2009). Poor diet and nutrition might cause "additional stresses, emotional disruptions, and learning disabilities that seem to originate in the toxic environment and processed food that we provide for them" (Berry, 1996, pp.15-16). Perhaps schools that provide healthy, locally produced, and organic foods could aid children in supporting the physical and mental capacity for learning. School gardens and student-run kitchens may not only improve school nutrition, but might also support the living systems where children live.

Emotional well-being ranked fifth on the list of priorities in the results of the ESCS. Parent desire for emotional health outstripped reading, math, and even sports, which are commonly recognized as important in the community (Boulmier-Darden, et al., 2011, p. 21). Concern about the emotional safety in Española may not be surprising to those who recall the international headlines about a third grade student who was arrested, booked into the local jail, fingerprinted, put in an orange jumpsuit, handcuffed, escorted to a cell, and then taunted by inmates in the next cell. The original complaint about this student that led to the arrest was for "maliciously throwing a ball" (Salazar, 2005). The story uncovered what appeared to be a pattern in Española of booking students at the local jail, though the facilities were not authorized to handle juveniles.

The emotional and physical well being of children in Northern New Mexico may be directly related to the area's most publicized social concern--heroin addiction. The New York Times ran an article about the Española heroin problem—Rio Arriba county was ranked first in drug related deaths in the country in 2005--with a rate of 47.5 per thousand compared to the

national average of 7.3 (Ekholm, 2008). The article described the area, stating that "nearly everyone...seems to have friends or relatives who died from drug use" and that approximately 12,000 needles are exchanged each week (Ekholm, 2008). One recovering addict reported that he knew of "at least a dozen families in which grandparents, parents and children all injected drugs" (Ekholm, 2008). Perhaps the conditions for emotional and physical well being might cause some to give up on life altogether. The suicide rate in New Mexico was three times the national average in 2004 for ten to seventeen year-olds (CDC, 2004). While New Mexico children obviously face many issues, my travels to Algiers presented a whole new picture of the challenges of children.

Environments of Children in Algeria

Accurate statistics and data regarding the status of children in Algeria are difficult to obtain and official government reports tend to differ widely from reports compiled by non-governmental agencies (Braham, 2012). In my experience, Algerian students and their parents appear to be greatly distressed in relation to education. Many students and parents express worry about performance on exams. "Violent discipline" strategies, as defined by UNICEF, are used with 88% of Algerian children in homes (2012). Often, this violence appears to be centered around school exam performance or other in-school behavior, including discipline, forgetting one's backpack or belongings, and soiling one's clothes. I have seen children spend much time worrying about punishment from either teachers or parents, even for simple accidents, such as spilling food on one's shirt.

According to Algeria's UNICEF early childhood program manager, Lylia Braham, only four percent of Algerian children remain enrolled in school continuously from kindergarten

through graduation of high school (UNICEF, 2012). Education in Algeria is mandated by law and parents have the choice to send their children to public or private schools. Homeschooling is illegal and those who choose to homeschool risk jail time if they are caught.

I found that public school classrooms in Algeria are nearly impossible to observe and reliable data about Algeria schools is also extremely uncommon. The school grounds are closed to parents; children are dropped off outside and parents may never see the interior of the school. According to one state-sponsored program director, who wished to remain anonymous, Algerian teachers received very little training (personal communication, 2012). In my experience, private Algerian schools classrooms consist solely of desks, a trashcan, a wipe board with limited space, and many students. I observed that it is common to have book shortages and many students are left to share books or use photocopied books.

Public school teachers in Algeria are well-known to use corporal punishment to maintain order in their classrooms—I have been told that spanking, slapping, yelling, and isolation are used as common methods of discipline for children who misbehave, fail to complete their homework, or give an incorrect answer (personal communication, 2012). Private schools are quite expensive, with annual tuition rates ranging between 100,000-200,000 Dinars a year, or roughly 1,000-2,000 US Dollars (USD). The average annual Algerian income per capita was 44,000 Dinars or 4,460 USD (UNICEF, 2012), which keeps private education unavailable to most.

During the height of recent social unrest in North Africa in spring 2011, I made my first visit to set up the Montessori program at Madrasat Ardh al Amel. While I was in there, a number of Algerians set themselves on fire--an idea sparked by the self-immolation of Tunisian activist

Mohammed Bouazizi. One of these incidents was carried out by a 19-year-old student who was refused to retake his baccalaureate (for graduating high school students) exam in Oran, Algeria ("Student sets himself," 2011).

Food security, quality, and prices are major concerns that Algerian children have in common with New Mexican children. Many of the immolations that took place in the spring of 2011 in Algeria were in protest of rising prices for basic food items such as oil, sugar, and flour.

During my stay, I noted that school playgrounds are rare. A typical Algerian schoolyard is comprised of a dirt or asphalt courtyard in the center of the school. Parks in Algeria are also rare, with perhaps one small green space in each suburb of Algiers, most of which are very dirty. Connection with nature appears to be largely ignored. Population density in the metro Algiers area is quite high, with many residents living in massive concrete apartment complexes that house hundreds of families on a few acres of land. The figure below shows a view of the French Quarter tenements from the Casbah.

Figure 12. View of the French Quarter apartments and Casbah, Algiers, Algeria (Boulmier-Darden, 2012).

From my experience, present conditions for children are not optimal for producing creative, complex thinkers who are able to address the problems this generation will leave for them. I found many correlations with Krishnamurti's assertion that children are being turned out

"as if through a mould, a type of human being whose chief interest is to find security, to become somebody important, or to have a good time with as little thought as possible" (1958, p. 9). Like Krishnamurti and Montessori, Berry was also very concerned about the ways in which children have been introduced to the world around them. He offered,

> We dedicate enormous talent and knowledge and research in developing a human order disengaged from and even predatory on the very sources from whence we came and upon which we depend very moment of our existence. We initiate our children into an economic order based on exploitation of the natural life systems of the planet. To achieve this attitude we must first make our children unfeeling in their relation with the natural world. This occurs quite simply since we ourselves have become insensitive toward the natural world and do not realize just what we are doing. Yet if we observe our children closely in their early years we see how they are instinctively attracted to profound experiences of the natural world. (1999, p. 15-16)

My observations and experiences in both New Mexico and Algiers show the great need for a world community that explores and relates connection to the Earth, mutual understanding, and the new sciences to children through education.

Chapter 4: The New Sciences and Education

Many discoveries and insights from the twentieth and twenty-first century may be seen to support a shift away from the mechanistic models of the past and point towards an integrated view of living systems on Earth for the future. Physicist Albert Einstein's surprising discovery of an omnicentric, expanding Universe may be seen as the biggest shift in science of the twentieth century. This discovery shattered the prevailing view of the composition of the Universe and may still be seen as paramount in human understanding of the nature of living systems. Other scientific investigations, such as wave-particle theory and the concept of autopoiesis, are among

the topics in the new sciences that might inform how we view life on Earth and our role in living systems.

Modern science from the 20th and 21st century provides many opportunities for supporting educational models based on the integration of living systems. Shifting educational thinking away from Newtonian perspectives and towards the new sciences may be vital in supporting integrated education. Educational models supported by current research and theory, such as Montessori, Place-Based Learning, Environment as the Integrating Context, Bioregional Education, and sustainable agriculture may be seen as concepts supporting learning in living systems. A brief review of these models may prove relevant for this paper.

The Newtonian Model and Mechanism

The statement "shifting educational thinking away from Newtonian perspectives" refers to the perspectives that evolved from the context of Sir Isaac Newton's work. From 1642-1727, Newton was an English physicist, mathematician, astronomer, philosopher, and theologian. Though his contributions to the advancement of human knowledge are diverse, he is perhaps most well known for the 1687 publication of *Philosophiae Naturalis Principia Mathematica*. In this work, Newton described the three laws of motion and universal gravitation, which explained the movements of the planets and celestial bodies.

Newton's calculations and differential equations were also used in astronomy, physics, and mathematics to explain the motion of water, vibrations, and other elastic bodies. A broad range of phenomena could be explained using Newton's formulas, which strengthened the notion that all phenomena in the universe could be described with mathematical certainty. It followed also that the processes of life could be broken down into discernible parts, as with a

watch, to study each distinct part. Each part of the watch may be examined for its properties and understood for the part that it plays in the function of the whole.

In the early twentieth century, Newton's theories concerning the movement of planetary objects prevailed in the scientific world; however, his equations were limited. Exact solutions were not easily evident in many problems and, as systems thinker Capra suggested, "the complexity of vast areas of nature seemed to elude all mechanistic modeling" (1996, p. 121).

Einstein's work with relativity proved Newton's mechanistic model no longer applied to a holistic understanding of the Universe.

Relativity and the New Metaphors

Albert Einstein was a German-born theoretical physicist who won the Nobel Prize in 1921 and is generally regarded as the father of modern physics. Einstein approached relativity from a Newtonian context. In 1914, as he worked alone at his desk, he stumbled upon a fact that would shake the very foundation of science. Swimme described the night Einstein's paradigm shifted from an unchanging mathematical world to one of infinite complexity:

> Einstein was stunned into bafflement by what he was seeing. Through these symbols the universe whispered that it was expanding in all directions. No one in three centuries of modern scientific work had imagined such a possibility. All his life Einstein had assumed the universe was an unchanging infinite space. Now he was confronted with the idea that space was expanding in every direction. This was not a minor modification. This was an idea that, if true, would shatter the world-view of everyone, Einstein included. (2004, pp. 71-72)

Perhaps the implications of this revelation were too vast for Einstein to ponder at the time, for he revised initial calculations that would preserve understanding of the universe in the Newtonian context. Altering the original calculations, Einstein added a "cosmological constant"

or “fudge factor” to the mathematical formula. The constant allowed for the universe to retain the “watch with no maker” identity (Swimme, 1996, p. 64). However, the watchmaker idea would be shattered in the field of astronomy.

In 1922 and 1923, astronomer Edwin Hubble peered through a telescope that was powerful enough to capture glimpses much deeper into space than previously imagined and found that other galaxies existed in the Universe. In 1924, Russian cosmologist Alex Freidmann removed the cosmological constant to Einstein’s relativity equation, and the result was the revelation of an expanding universe, just the idea that Einstein had sought to suppress (as cited in Swimme, 2004, p. 72). Einstein himself was only able to accept the idea after peering through Hubble’s telescope and seeing it firsthand.

The prevailing metaphor for physics in the 1920‘s was a “foundation” on which all other sciences were built. With the discovery of the expanding universe, what was considered a rock “foundation” began to shift-so much so that even the metaphor no longer seemed appropriate. Scientific developments such as quantum theory, chaos theory, and dynamical systems theory led to new metaphors in science that are more reflective of continuously changing webs, networks, or possibilities (Capra, p. 268).

May society at large, and specifically educators, incorporate the shifts in thinking about the universe into ways that approach modern understanding? The worldview of physics may have drastically changed as a result of Einstein’s work, but society at large appears to be lagging behind. Systems thinker Margaret Wheatley suggested that many institutions still organize structurally according to Newtonian models:

> Each of us lives and works in organizations designed from Newtonian images of the universe. We manage by separating things into parts, we believe that influence occurs as

> a direct result of force exerted from one person to another, we engage in complex planning for a world that we keep expecting to be predictable, and we search continually for better methods of objectively measuring and perceiving the world. (1999, p. 7)

Physicist Frank Oppenheimer appeared to support integrating new scientific models into other areas of life. He offered, "If one has a new way of thinking, why not apply it wherever one's thought leads to? It is certainly entertaining to let oneself do so, but it is also often very illuminating and capable of leading to new and deep insights" (Cole, 1985, as cited by Wheatley, 1999, p. 15). As humanity continues to move forward in time from Relativism, the new sciences offer views of interrelated webs of cause and effect, myriad shades of grey or perception, and possibilities for new interpretation. One area of science that may offer views for reflection on society or education is quantum physics. TIES core faculty Philip Gang, in *Rethinking Education* (1987) wrote,

> In the world of quantum theory, probability overshadows certainty. Matter shows tendencies to exist, and particle behavior and location is predictable only within limits of probability. The old cause-effect way of interpreting phenomena falls to oblivion since events can no longer be predicted with absolute certainty. (p. 33)

What may individuals or educators gain from reflecting on quantum physics? Einstein famously offered, "No problem can be solved from the same consciousness that created it" (as cited by Wheatley, 2006, p. 7). Perhaps the problems facing humanity and education may be approached from the new consciousness that quantum physics offers. Wave particle theory appears to be one such phenomenon that is challenging previous principles of science and ways of thinking.

Wave-Particle Theory

One way of interpreting the implications of living in a post-relativity world is that solid facts or certainty are hard to define. Looking at the world in terms of possibilities, individual interpretation may be supported through scientific work such as wave-particle theory and what has come to be known as the "double slit experiment." This experiment sheds light on the dual nature of matter, which exhibits properties of both particles and waves.

The double-slit experiment, devised in 1803 by physicist Thomas Young, would go on to be studied by physicists Max Planck, Niels Bohr, and Einstein as well as many others. Work on the duality of matter began with debates about the nature of light and whether light behaved as waves or as particles. In the double-slit experiment, photons, or tiny particles of light, were shot towards a plate in which there were two slits. Expecting the photons to behave as matter, or tiny balls, the physicists predicted that two lines of photons would illuminate the wall behind the double-slit panel. When the experiment was carried out, however, they discovered a series of lines, in what is known as an "interference pattern," which is a result of wave particles, not matter (Buckwald, 1989).

To illustrate this concept, one can imagine tiny balls being shot through a metal plate with two slits onto the wall behind. The balls would either go through one slit or the other, creating two lines on the wall. But if, instead of tiny balls, or matter, a quantity of water were pushed through the plate, the water would flow through both slits and create waves. As the waves flowed outward, the top of one wave would meet the bottom of another, canceling out the two waves and creating a pattern of multiple lines on the wall behind. This is what physicists saw in the double-slit experiment.

How could particles of matter exhibit wave-like patterns? Physicists installed a device at one slit to observe whether the particles were splitting or going through one or the other slit. When the device was observing, the particles created a pattern on the wall according to the behavior of matter. When the device did not observe, the particles behaved as waves. Physicists attempted to "trick" the particles by drawing away the device until just before the particles hit the wall, yet the results were always the same. Whether or not a particle behaved as a wave or particle depended on whether or not it was being observed (Gribbin, 1984, p. 169-74, as cited by Wheatley, 1999, pp. 64-65).

The paradox of wave-particle theory may have deep implications, not only for physics, but also for the very nature of reality. If one cannot say for certainty that something exists, then it may follow that what has been regarded as "truth" or a "fact" may more accurately be described as a "probability." Further, if the act of observation automatically changes that which is being observed, then the concept of "objectivity" is also called into question. Wheatley described the implications of observation in the following way.

> Every time we go to measure something, we interfere. A quantum wave function builds and builds in possibilities until the moment of measurement, when its future collapses into only one aspect. Which aspect of that wave function comes forth is largely determined by *what* we decide to measure. (1999, p. 64)

Apparently if we desire to see particle, then we shall see a particle; if we desire to see a wave, then we shall see a wave. Not only could this concept have deep implications for human understanding, but it may also be seen as having direct implications for education, where observation and measurement are regarded as important indicators of success or failure. Wheatley offered that

> every observation is preceded by a choice about what to observe...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 lenses to filter and select. We each actively participate in creating our worlds. (1999, p. 65)

If particles cannot be defined with certainty, how may educators know if what they are measuring or observing in students is indicative of anything more than what they desire to observe? This question raises valuable concepts for educators interested in the new sciences to reflect upon. Wave-particle theory may cause educators to approach measurement (such as test scores) with an awareness that "every act of measurement loses more information than it gains" (p. 65) and inquire into the information that was *not* measured.

Wave-Particle theory offers insights into observation and possibilities. Is there work in the new sciences that provides an overarching framework for living systems education? Perhaps the concept of autopoiesis may be applied in this context.

Autopoiesis

Autopoiesis is a term introduced by Chilean biologists Humberto Maturana and Francisco Varela. Capra described autopoiesis as "the pattern of organization of living systems" that is "continually reproducing itself"(1997, pp. 161-162). Capra suggested that autopoietic systems are a "set of relations among processes of production of components" and that they "must continually regenerate themselves to maintain their organization" (1997, p. 168).

Maturana, in a paper titled *Autopoiesis, Structural Coupling, and Cognition,* explained a breakthrough in his understanding of living systems in 1963. He and a colleague were examining the process whereby nucleic acids

> participate with proteins in the synthesis of proteins, and that proteins participate as enzymes with nucleic acids in the synthesis of nucleic acids, all together constituting a

> discrete circular dynamic supported by the continuous flow of the molecules that we usually call metabolites. (Maturana, 2002, p. 7)

This theory of the simple living system, composed of self-creating parts, has evolved and been interpreted to include living systems of many characteristics, including humans, the Earth, cognition, and society. One example of an autopoietic system may be a simple biological cell, the basic building block of every living organism on the Earth. The contents of a cell are contained by a thin cell wall or membrane. Inside each cell, there is a nucleus, which contains the genetic material to reproduce, and organelles, which carry out molecular processes for producing individual parts of the cell by recycling old parts and maintaining life inside the cell walls. These organelles are in a continuous state of constructing the cell, which in turn, constructs the organelles. Cells may be seen as living systems just the same as a self-creating system in nature is called an ecosystem (Capra, 1997, pp. 162-163).

Autopoiesis: Ecosystems

An ecosystem is a community of living organisms that resides in conjunction with the non-living organisms in the environment. For example, in the African savanna of Kenya, each living organism needs energy and nutrients for growth, respiration, and reproduction. Energy is continuously generated from the sun and flows through plants, like the savannah grass, via photosynthesis. The energy is then captured by herbivores, such as gazelles, which eat the grass. Predators, such as the lion or hyena, consume herbivores like the gazelle and the remains are often consumed by scavengers such as the vulture.

Finally, decomposers like worms and maggots feed on the remaining flesh of herbivores and other life forms that have expired. Decomposers nourish the soil and prepare it for the

regeneration of life, such as new growth of the savanna grass. Each organism releases part of the energy flow, which is taken through heat, into the ecosystem and cannot be recovered. The sun's continual generation of energy provides nearly limitless new energy to the ecosystem and the organisms within it.

Unlike energy, which flows through the living organisms of the savannah, nutrients go through a process called cycling. Nutrients such as carbon, nitrogen, phosphorus, and water are necessary to carry out the processes of life in organisms and are continuously recycled within the ecosystem. Each organism living in the savanna depends on the entire system for nutrients and the flow of energy.

The interdependent nature of the savanna ecosystem could be reflected in the consequences of a severe drought. A drought may cause die-off of savannah grasses, resulting in loss of life to herbivores, which in turn may cause carnivores, scavengers, and even decomposers to die off. Loss of life in the ecosystem almost certainly leads to depletion of organic matter in the soil.

Soil depletion, if severe enough, can lead to desertification as the soil becomes unable to support life in the form of plant material. The concerns about desertification in Africa, as outlined earlier in this paper, cover a vast area, including the savannas, which border desert areas. For the system to maintain stability, each organism relies on the balance of the ecosystem--not only for survival, but also for the survival of the ecosystem itself. Because the components, taken as a whole, comprise the ecosystem and because the biome generates the components, each ecosystem may be regarded as autopoietic, or a self-making system (Capra, 1999, pp. 267).

Other examples of autopoietic systems may include the water cycle, the carbon cycle, as well as the Earth and the vast Universe. James Lovelock's Gaia Hypothesis is an illustration of how the Earth may be considered an autopoietic living system.

Autopoiesis: Gaia Theory

Atmospheric chemist James Lovelock studied atmospheric gases in the 1960's at the Jet Propulsion Laboratories in Pasadena, California. He was working with NASA to develop instruments, which could detect if life on Mars was possible by analyzing the chemical composition of atmospheric gasses. Observing the atmosphere on Earth, Lovelock realized that concentrations of different gasses were not in a state of equilibrium, but far from it (Capra, 1996/1997, p. 101).

Lovelock theorized that the lack of equilibrium in Earth's gases was the result of continual processes in waste production from plant and animal life. As a result, these processes would constantly change the makeup of chemical components in the atmosphere (Capra, 1996/1997, pp. 101-102). Mars, on the other hand, had an atmosphere that *was* in a state of equilibrium and had apparently already carried out all chemical processes (Capra, 1996/1997, p. 102). Therefore, Lovelock correctly predicted the absence of life on Mars, and this discovery began his journey towards the development of Gaia theory (Capra, 1996/1997, pp. 101-103).

Gaia theory not only rests on the belief that all of creation is interrelated, but also that scientific disciplines are best understood in context with each other. Further, Capra explains that key to Gaia theory "is the complex interweaving of living and non-living systems within a single web" and that "living beings come out of rocks and go back into rocks" (1996/1997, p. 215). When the systems of Earth are viewed through the lens Gaia, the rocks, the water, and the

atmosphere are not separate from life, but rather inextricably intertwined in the process of life. (Capra, 1996/1997, pp. 213-216).

The body of knowledge known as the new sciences defines an influential shift from the old science of mechanism and Newtonian thinking towards a more holistic view of science through the discoveries of Einstein and the theory of relativity. Wave-particle theory could point to a world that is less easily definable than was previously thought. Autopoiesis is a lens through which one might observe many kinds of living systems, like cells, individuals, ecosystems, and the Earth. These examples of the new sciences create a context that may be applied to education.

Education in the Context of New Science

Just as science is shifting into a new paradigm, present-day environmental, social, and individual challenges for humans also call for shifts in the many ways we interact with our world and each other. Berry, looking at the circumstances that brought humanity to the present situation, remarked,

> We need to give them some indication of how the next generation can fulfill this work in an effective manner. For the success or failure of any historical age is the extent to which those living at that time have fulfilled the special role that history has imposed on them. No age lives completely unto itself. Each age has only what it receives from the prior generation. (1999, p. 7)

The present generation of children did not choose the circumstances of the environment they were born into, they received it from their elders, as Berry explained. The children of the present also have available new insights and possibilities--knowledge of an interconnected Universe, of relativity, possibility, and self-creation all present potential insight for the new generations. These potentials, if shared and utilized in the context of education in living

systems, might bestow upon the new generations the necessary tools required to address the challenging circumstances they have received. One approach to learning in living systems is place-based education.

Place-Based Education

Place-based education is a term that refers broadly to using school grounds, community, and culture to present material in a meaningful way that covers traditional academic topics. Educator Herbert Broda, author of *Schoolyard Enhanced Learning,* suggested that nearly any topic in a school curriculum could be addressed in the outdoor environment, school grounds, or local community (1998, p. 13). Other aspects of the approach include utilizing concrete experiences and materials for learning abstract concepts, providing fresh settings for reluctant learners, and encouraging learners with strong abilities in Gardner's naturalistic or kinesthetic intelligences. Broda reported results of a Florida study that showed learning in outdoor environments significantly increased achievement enthusiasm in students (Place Based Education Collaborative, as cited by Broda, 1998, p. 18). Berry indicated that the sense of individual and contextual identity might be challenging for a modern child in the age of globalization:

> we, the peoples of the industrial world, no longer live in a universe. We in North America live in a political world, a nation, a business world, an economic order, a cultural tradition, a Disney dreamland. We live in cities, in a world of concrete and steel, of wheels and wires, a world of unending work. We seldom see the stars at night or the planets or the moon. Even in the day we do not experience the sun in any immediate or meaningful manner. Summer and winter are the same inside the mall. Ours is a world of highways, parking lots, shopping centers. (1999, p. 15)

For the Maori people of New Zealand, there is an expression for the sense of belonging to a place, "a place to stand," or "Tūrangawaewae" (Waring, 1995). Proponents of "Place Based

Education" like educator Herbert Broda may approach tūrangawaewae through regarding the school grounds and local community as central to the learning process (Broda, 1998, p. 9).

Learning in one's own environment may include considerations of the bioregion and its features, resources, culture, and customs. For instance, it may be hard for children in both New Mexico and Algeria to conceptualize what the ecosystem of the African savanna is like and they may be unlikely to ever directly experience being in that ecosystem. However, most New Mexican children spend some time in an arroyo, or dry streambed, and may be familiar with the plants, animals, and other life forms that cycle through the arroyo. Most Algerian children may not know what an arroyo is, but they probably have been to the Sahara or have family who live there. Presenting information about the autopoietic nature of ecosystems might be most effective if it is done in an experiential way and in a familiar setting.

Gerald Lieberman and Linda Hoody were among the early researchers to focus on the environment as a learning context rather than as a curriculum topic. Their 1998 research study, published in a report titled *Closing the Achievement Gap: Using the Environment as an Integrating Context for Learning*, found that outdoor instruction increased performance on standardized tests in reading, writing, math, science, and social studies (as cited by Broda, p. 19). The findings also included a reduction in classroom management problems, increased enthusiasm, and pride in accomplishment (as cited by Broda, 1998, p. 19).

A recent study indicated that California student performance on science tests was enhanced after a week in the woods (Stiffler, 2007). Further research such as this may lead to evidence that learning in outdoor environments helps with psychological disorders, including reducing symptoms of hyperactivity and ADD. In the years since the publication of *Last Child*

in the Woods, many schools and children's programs have scrambled for ways to get children outdoors (Stiffler, 2007). One might wonder, though, at the approach these programs take. Following Louv's suggestions, programs that expose children to nature may consider opportunities in the natural world that allow for exploration, touching, and experiencing without unnecessary restrictions and interventions.

How may school gardens aid integrated learning?

School gardens

Capra discussed the school garden as an optimal learning environment for the exploration of the New Sciences in an interview with TIES faculty Marsha Morgan and Philip Gang (2009). Capra explained that for children, learning complex concepts must take place on a scale that they can relate to and that the garden is an optimal scale (2009). Through working in the school garden, Capra asserted that children could examine a school ecosystem and participate in community building activities (2009). He explained that when the garden is connected with the cooking of food, the processes of metabolism, the intake and processing of food, becomes active learning for children and may reconnect them to the fundamentals of life (Capra, 2009).

Alice Waters, owner and chef at Chez Pannise Restaurant, spearheaded the Edible Schoolyard (ESY) project in 1996 at Martin Luther King Jr. Middle School in Berkeley, California. Waters trained as a Montessori teacher in England and taught for four years before opening Chez Pannise. The Edible Schoolyard is unique in the realm of school gardens. The students not only grow food, but they also cook and eat their harvest each day. This process integrates work in the garden and kitchen across the curriculum with math, science, and language, economics, and ecology (Waters, 2008, p. 43).

Years of experiences developing the ESY led to the development of several guides for schools wanting to begin similar projects. Among these are the *Garden Companion* and the *Kitchen Companion*, which are free and downloadable. These guides are complete with materials lists and detailed descriptions of composting, preparing beds, propagating, harvesting, kitchen etiquette, recipes and lesson plans. The *Garden Companion* stresses that "a thriving, complex garden system does not happen overnight-it takes years of cultivation and careful observation" (Villanueva, 2008, p. 11).

In accordance with individual state standards, the US Common Core Standards are designed for students to learn specific information according to a particular grade. The New Mexico Content Standards and Benchmarks, for example, expects fourth grade students to know that "roots are associated with the intake of water and soil nutrients and green leaves are associated with making food from sunlight" (NMPED, 2006, p. 306). Would it be valuable for students to learn this much earlier through experiential lessons?

It is not until sixth grade that New Mexico students are asked to understand that "weather and geologic events affect the function of living systems" (NMPED, 2006, p. 306). In the case of the school garden, changes in rainfall patterns, snowfall, and other weather would present obvious results to the life of the garden. If rainfall were below average for instance, the plants would need to be watered more frequently to prevent them from dying. Fourth grade students could be exposed experientially to many aspects of living systems well before sixth grade by caring for and growing food. The Edible Schoolyard reported increased ownership of work by students and opportunities to work with others they might not normally choose and the *Garden Companion* offered additional benefits,

> From the first time students sift compost or observe a bee flying from flower to flower, they are introduced to the many webs that bring the garden to the life. The garden helps students grasp these connections and shows them that they too are active agents in a complex ecological web. (Villanueva, 2008, p. 15)

The ESY guides stress that each garden is unique and best designed and built by the students themselves in the context of the community in which it is located (Villanueva, 2008, p. 10). The kinds of materials, plant varieties, and design elements available for a New Mexican garden will be quite different from those in a place such as Algiers. New Mexico has particularly well-defined agricultural practices that may be incorporated into school design.

Based on survey results and the La Tierra design, the school garden and kitchen were set as high priorities and were designed to honor local practices and traditions. In northern New Mexico, local traditional practices and culture are centered around the acequia, or water irrigation system, which was developed centuries ago. The acequia system was created to ensure that each family had access to water for irrigating their apple and apricot orchards, as well as for crops such as the New Mexican chile, corn, beans, squash, and tomatoes that serve as staples of subsistence local farming. The acequia system is run by the "mayordomos," a council that meets annually for the Congresso de las Acequias to discuss water rights, that the acequias and ditches are clean, that the correct gates are open at the correct times for individual family plots, and that any disputes about water are resolved.

Agricultural practice in New Mexico is unique in that it has specific ceremonies and celebrations that are centered on food production and water. In the spring and fall, the mayordomos gather neighbors to clean the acequias of tree limbs, leaves, garbage, and other debris. Cleaning the acequia literally clears the path for new life to emerge in homes through the

life-giving power of the water. Local farmers watch the snowmelt on the mountains to determine the time to plant, which is a tradition practiced in Native American pueblos Santa Clara, San Ildefonso, and Ohkay Owingeh. Once the proper amount of snow has melted, farmers throughout the valley sow their seeds and celebrate planting.

Harvest celebrations specific to the culture of northern New Mexico center around the life-giving properties of the acequia and the cycle of the seasons. Designing meaningful ways of integrating acequia culture into the culture of La Tierra appears to have particular importance in that environment. Gardens in Algiers differ widely in culture and practice from those in New Mexico, and may be designed and built with specific considerations appropriate for that community.

Learning in school gardens, kitchens, and outdoor environments may help shift perspectives about the value of growing food, caring for animals and the Earth--from a purely economic pursuit--to a living in relationship with the natural world.

Economic Value in Living Systems

Marilyn Waring is a former New Zealand Member of Parliament, feminist, and economist who began working with women and economics in the 1970's. Many of the women she encountered spent the majority of their time learning experientially in living systems-subsistence farming, management of households, and the care of children. While studying global economics and the United Nations System of National Accounts in New York, Waring came across a passage addressing these subsistence workers that she found shocking: "subsistence production and the consumption of their own produce by non-primary producers is of little or no importance" (Waring, 1995).

Waring has worked to challenge the beliefs that underlie the policies of the UN System of National Accounts. She has also worked to shift beliefs that form a basis for similar policies regarding the Earth's resources, which has no economic value other than what can and should be extracted for the maximum economic activity available without regard to environmental damage. These kinds of economic perspectives certainly may need to shift if humanity is to adopt an Earth-oriented approach to systems.

In the horn of Africa-Kenya, Ethiopia, and Somalia--where the recent famine affected over 12 million people--54,000 refugees from Somalia crossed into Ethiopia and Kenya in one month in 2011 (Flood, 2011). In Ethiopia, more than 50% of children arrived with serious malnutrition, and many children were perishing on their way to the camps or shortly after their arrival (Flood, 2011). In these drought-affected areas, village women abandoned their subsistence homes, crops, and animals to seek refuge in camps.

Women in this and many other regions of the planet have devoted large amounts of time to such work as retrieving water-often from a community well, caring for animals, and gathering firewood. A large portion of this daily activity takes place in the outside environment, where the children participate in the regular work of maintaining the household. Though formal education may be lacking for these women and their children, they are certainly immersed in place-based, bioregional education. Indeed, their survival may well depend on an intimate understanding of local weather patterns, crop sustainability, and animal husbandry-subjects that many American children have little exposure to experientially.

Children who are educated in place-based, bioregional, agricultural settings might be inclined to see the value of subsistence work quite differently from the present view of the global

economic system. It may be possible for these students to find new solutions that include honoring the care and management of households as a vital, honored duty, and even an essential part of restoring a balance on the Earth. Berry wrote,

> We dedicate enormous talent and knowledge and research in developing a human order disengaged from and even predatory on the very sources from whence we came and upon which we depend the very moment of our existence. We initiate our children into an economic order based on exploitation of the natural life systems of the planet. To achieve this attitude we must first make our children unfeeling in their relation with the natural world. This occurs quite simply since we ourselves have become insensitive toward the natural world and do not realize just what we are doing. Yet if we observe our children closely in their early years we see how they are instinctively attracted to profound experiences of the natural world. (1999, pp. 15-16)

A child who has gone to the trouble of caring for a carrot from the seed stage to maturation will likely see the value in such a process. If the child has the opportunity to wash, cut, and cook the carrot, they will be experiencing the entire life cycle directly and may come to appreciate more fully their place in that cycle. Montessori education may be an excellent context for such learning experiences to take place. With regard to a shift in education to adequately prepare children for the complex issues they will face in the future concerning the human relationship to the Earth, Montessori education may be considered an appropriate model for such an education.

Chapter 5: Montessori Education and Living Systems

> While a new alignment of our government, our institutions, and our professions with the continent in its deep structure and functioning cannot be achieved immediately, a beginning can be made through our educational programs. Especially in the early grades of elementary school, new developments are possible. Such was the insight of the educator Maria Montessori in the earlier part of the twentieth century. (Berry, 1999, p.16)

Maria Montessori

Maria Montessori was born in Italy in 1870. As a young student she was quite proficient in math, which was not a commonly accepted course of study for girls at the time. After excelling in studies of math and science, she decided to become a doctor, which was unheard of for that time. She studied at the University of Rome and went on, after pressing her father and overcoming the prejudices of the physician's program, to become Italy's first female physician. After graduating from medical school, Montessori studied and published papers on childhood nervous disorders and was an examiner in the Faculty of Pedagogy at the college for women, Magistero Feminile. In 1904, she became a professor of Anthropology at the University of Rome, where she published her first work *Pedagogical Anthropology*. (Standing, 1957/1998, pp. 21-33).

Montessori began giving lectures at the University of Rome and became a popular speaker, well known for her charismatic talks and, as one attendee described, "conscious of each one individually with what one might describe as a kind of spiritual contact" (Anna Maccheroni as cited by Standing, 1957/1998, p. 34). Montessori worked as a physician in private practice along with her other appointments, and was highly regarded in the community. Montessori

began working with children in 1905 after being appointed to the Psychiatric Clinic in Rome. Her duties included visiting an asylum for so-called "idiot" children. She observed the children at great length and saw that they had no materials to play with, which convinced her that "mental deficiency was a pedagogical problem rather than a medical one" (Standing, 1957/1998, p. 28). After preparing materials for these children and working with them, several were able to take the state exams and the results exceeded expectations. This led to questions about what kinds of results could be achieved if her approach was applied to "normal" children. (Standing, 1957/1998, p. 37)

In 1907, Montessori embarked on a project that would cause her name to be known the world over. There existed a slum known as the San Lorenzo quarter, a suburb of Rome, where huge apartments buildings had been erected to house the "poorest class of the whole city" in an area of "squalor, poverty, and crime" (Standing, 1957/1998, p. 36). The apartments were inhabited by low-wage factory workers whose unsupervised children "played up and down the stairs and corridors, defacing the walls and staircases and generally creating disorder" (Standing, 1957/1998, p. 36) while both parents were away working in the factories. Developers decided it would be economically advantageous to hire someone to supervise the children, rather than paying for repairs. Montessori was asked to perform this task and a room was prepared with little chairs and tables, armchairs, and equipment. I imagine the task of bringing order to this environment may have seemed daunting to many—including the children, who Montessori described as "sixty tearful, frightened children, so shy that it was impossible to get them to speak; their faces were expressionless, with bewildered eyes as though they had never seen anything in their lives..." (as cited by Standing, 1957/1998, p. 37).

According Standing, who wrote *Maria Montessori: Her Life and Work,* Montessori discovered in the children at San Lorenzo a love for order. The children wanted to care for materials themselves, keeping the classroom tidy and organized (1957/1998, p.41). Montessori also observed children spontaneously sought to learn reading, writing, and mathematics (Standing, 1957/1998, p. 41). Using materials Montessori prepared, the young students excelled in their studies, seemingly having gone through a transformation, according to Montessori's account:

> Their bodily movements became more harmonious; their very expressions serene and joyful. Everything about them beckoned a heightened interest in life, and with it a new form of dignity. They looked--as indeed they had become--independent personalities with power to choose and carry out their own acts. They did not abuse the liberty which had been granted to them. Rather this liberty was the very means through which they were able to reveal this new self-discipline. (as cited by Standing, 1957/1998, p. 51)

The success at San Lorenzo gained Montessori immediate international recognition and she was soon traveling around the world, speaking about her "discovery of the child" (as cited by Standing, 1957/1998, p. 35). This approach to education flourished and training guides in Montessori schools developed around the world. Montessori spoke to a packed house at Carnegie Hall in 1915, where she received a warm welcome (Standing, 1957/1998, p. 63). Montessori became a guest of inventor and admirer Thomas Edison. Alexander Graham Bell, inventor of the telephone, formed the American Montessori Society, serving as the president (Standing, year, p. 63).

Montessori wrote, lectured, and trained teachers throughout the remainder of her life. She developed an extensive array of didactic manipulative materials, descriptions, and charts of sensitive periods concerning child development, pedagogical theory, and the preparation of the

adult guide. Her son Mario Montessori eventually joined her in the effort and established the Association Montessori Internationale. He also wrote and worked extensively on promoting Montessori education throughout the world. Her grandson Mario Montessori Junior, who became a psychologist, also has written and worked on behalf of Montessori and the work that she started over a hundred years ago.

Montessori schools have seen a sharp increase in the US in recent years (Matthews, 2007). In 2010, US Education Secretary Arne Duncan gave the commencement speech to the students of Clark Montessori School, a public Montessori high school in Cincinnati, Ohio (Fischer, 2010). In the same year, Jefferson Montessori School was awarded the Charter School of the Year award in New Mexico ("JMA named charter," 2012). In 2012, two of the eight newly approved charter schools in New Mexico were Montessori schools ("2011 Charter school applications," 2011). There are an estimated 8,000 Montessori schools presently worldwide, but the numbers are growing (Matthews, 2007). What is driving the increase in Montessori schools? Perhaps her general principles are being recognized for their worth.

General principles of Montessori Education

There are many references to the "Montessori Method" as a form of integrated or alternative education. The word "method" is defined as "a procedure, technique, or way of doing something, especially in accordance with a definite plan" (Webster online, 2012). An individual who understands the procedure, technique, or who has access to the plan theoretically should be able to apply that method. This is not the case with Montessori education. Montessori was hesitant to work with teachers who were already trained educators.

Angeline Lillard, psychologist and researcher, who wrote *Montessori: The Science Behind the Genius,* examines research in psychology and education as it relates to the Montessori approach. According to Lillard this approach is distinctly different from traditional education, where teachers were expected to "perform the function of running efficient classrooms that will enable children to pass exams at minimal expense to the taxpayers" (2005/2007, p. 257).

Montessori wrote that the word "method" should be replaced with "help given in order that the human personality may achieve its independence" or "means offered to deliver the human personality from the oppression of age-old prejudices regarding education" (1948/2007, p. 6). Montessori appeared quite clear about her perception of these "age-old prejudices" and stressed the importance of the adult to engage in continual inner transformation to overcome these prejudices through careful observation of the self and the child. Montessori wrote, "The usual conception of direct correction and suppression of defects is wrong" (1948/2007, p. 36) and that

> every form of agitation [is] caused by mental hunger when the child is deprived of the stimuli of the environment or by a sense of frustration experienced when he [or she] is prevented from acting in the environment. The 'unconscious aim' then moving ever farther from its realization creates a kind of hell in the life of a child who becomes separated from a leading source and its creative energies. (1948/2007, p. 35)

Montessori's definition of her approach seems to, perhaps purposefully, leave ample room for individual observation, interpretation, and flexibility in both adult guides and children. Action of the adult guide, therefore, may connect the adult directly to the individual child and environment--rather than adherence to any one "method." I perceive this kind of connectivity could be just what she was seeking by avoiding the word "method"-individual, autonomous

action organized in relationship with others and, if applied in today's terms, might be much like the organization of living systems.

Preparation of the Teacher

The concept of individual autonomy is a key aspect of Montessori education. Children are allowed freedom in as many respects as they can responsibly handle-freedom to choose what kind of work to do, where they will do it, and with whom. They are encouraged to work until they are satisfied and interruptions from others are avoided. Montessori stated it was imperative "that nobody interfere to obstruct the constructive spontaneous activity of the children in an environment prepared so that their need for development can find satisfaction" (1955/1989, p. 32). Much like self-organizing living systems, if allowed to function independently, Montessori classrooms are often observed as moving between order and chaos with increasing levels of complexity.

During the period when Montessori was developing her theories about children, the concept of the "tabula rasa," or blank slate concept, appeared to prevail among educators, philosophers, and theologians. The concept was based on the notion that children come into the world with empty minds and that the educator's job is to fill those minds with information, like filling an empty chalkboard or slate with writing. First referred to by Aristotle in the third century BC as the "unscribed tablet," the concept was popularized by the eleventh century by the medieval Islamic philosopher Ibn Sena, known commonly as "Avicenna" (Rahmann, 1954). The tabula rasa concept was later adopted by theologian Saint Thomas Aquinas in the thirteenth century and prevailed throughout the centuries as a central theme regarding children's capacities (Berry, 1999, p. 189).

Montessori presented a different view. She saw each child as a fertile field of unique origin, containing all of the potentials for their future development-much as a bean seed contains the potential to grow roots, shoots, leaves, flowers, and mature beans (Montessori, 1948/2007, p. 11). In order for the bean seed to grow into a healthy mature plant, however, specific needs from the environment must be met-air, sunlight, water, and the proper nutrients. Likewise, Montessori stressed the importance of preparing the proper environment for children. In *Formation of Man*, Montessori wrote, "we must cultivate the 'gardens' of the child with careful scientific examination" (1955/2007, p. 9). Individual children may be viewed this way also and when given a fertile environment stocked with many kinds of nourishing opportunities, a wild, unhampered landscape of wildflowers may bloom.

An observer new to Montessori education may be somewhat disoriented in an environment that moves between order and chaos. Unlike traditional thinking in education, in which there is correct behavior and incorrect behavior, Montessori education is oriented toward the connections between the individual and the environment. Montessori suggested providing limits when appropriate, being a safe haven when appropriate, and allowing independence when the child was able to work alone (Lillard, 2005/2007, p. 265). Rather than a Newtonian approach to discipline--which might punish incorrect behavior and reward correct behavior--the Montessori adult guide seeks to encourage and aid each child along his or her inner journey of self-discipline. By allowing the inner development of discipline to occur, in which adults may show children respect, another major quality of Montessori education may be fulfilled.

In an environment of individual choice and expression, integrated learning experiences may allow for each child to meet his or her own educational needs in the context of his or her unique interests.

Montessori Integrative Learning

In educational settings where each individual is encouraged to develop his or her own learning through unique interests, personality traits, learning styles, and choice, a great deal of options might be necessary to accommodate these different needs. Some may wonder about a need for more teachers. Most Montessori classrooms attempt to offer many different options for learning across curriculum and may be designed with different learning styles in mind, including kinesthetic elements. Students serve as instructors in addition to adult guides and older children often give lessons to younger ones or several students may work together on one material. This arrangement is supported both by the inclusion of three-year age spans in each classroom and by the purposeful limit of adult guides, who may inadvertently offer help that might otherwise be found through the children's own resources (Lillard, 2005/2007, pp. 201-202).

In order to continually integrate so many seemingly disparate academic subjects, a very large context may be sought and this may be what Montessori implied when she wrote, "'Since it has been seen to be necessary to give so much to the child, let us give him a vision of the whole universe. The universe is an imposing reality and an answer to all questions" (Montessori, 1948, pp. 5-6). To this end, Montessori wrote,

> This is the period when the seed of everything can be sown, the child's mind being like a fertile field, ready to receive what will germinate into culture. But if neglected during this period, or frustrated in its vital needs, the mind of the child becomes artificially dulled, henceforth to resist imparted knowledge. Interest will no longer be there if the seed be sown too late. (1948/2007, p. 3)

In Montessori's book *To Educate the Human Potential*, imaginative tales of the formation of the Earth, the oceans, and the emergence of land are woven with stories of early man and ancient human civilizations are presented to the reader. Some parents feel that there is not enough fantasy play included in Montessori classrooms. What Montessori did not support was adults using fairy tales and myths, such as Santa Claus, and "imposing their fantasies on children" (Lillard, 2005/2007, pp. 183-190). This perception seems to be a common charge when making the case against Montessori education.

Montessori addressed this topic in *The Right Use of Imagination,* offering the development of imaginative thinking about the real world, as opposed to fantasy. Montessori wrote,

> I consider it a crime to present such subjects as may be noble and creative aids to the imaginative faculty in such a manner as to deny its use, and on the other hand to require the child to memorize that which he [she] has not been able to visualize. These subjects must be presented so as to touch the imagination of the child, and make him [her] enthusiastic, and then add fuel to the burning fire that has been lit. (1948/2007, pp. 10-11)

Montessori's son Mario presented a series of "cosmic fables" in the late 1950's to a conference in Perugia, Italy, which preceded the work titled "The God Without Hands", from which the Five Great Lessons may have evolved. Though there is some debate about the content and contextual integration into Montessori classrooms, these lessons have become commonly used throughout many Montessori classrooms in the last thirty years. Presented as a series of nested stories of the development of the universe and life on earth, these lessons may set the stage for a sense of place in the living systems in which we dwell. The following is a brief description of each of the Five Great Lessons to illustrate the appropriateness of Montessori education for learning in living systems.

Lesson One: The Great Flaring Forth

The first of the Great Lessons is the story of the beginning of the universe--the Great Flaring Forth, more popularly known as the Big Bang, is perhaps the most important lesson in Montessori education for creating an integrating context. New insights into the universe, resulting from Einstein's revelatory finding may frame this story in Montessori classrooms to reflect current scientific knowledge and aid children in situating their place in creation.

Children may come to see how extraordinary this event was, especially to know that the conditions for the birth of the universe were just right. If there had been slightly more or less force in the initial explosion, then the results, most likely, would not have been the same. The story of the Great Flaring Forth tells of an explosion of great force that emerged miraculously out of seemingly nothingness, and contained the potential for everything in the universe that would emerge over billions of years. Simple gases--like helium and hydrogen--formed huge clouds, which shaped the first stars and galaxies (Swimme, 1996, pp. 110-112). Modern astronomy shows that within hundreds of billions of galaxies, billions of stars exploded as supernova, sending great clouds of gases into space that in turn gathered to form new stars and solar systems. Off in a distant corner of the Universe lies the Milky Way, an average-sized galaxy of two hundred to four hundred billion stars and comprised of a small cluster of galaxies attached to the much larger Virgo Cluster (just a small part of a vaster Supercluster), of which there are thousands in the known Universe. Neal Rogin, in *The Awakening Universe* explained,

> The universe arose and gave rise to the galaxies, the galaxies gave rise to the stars, our sun gave rise to the Earth, and the Earth gave rise to life and to all that we are. And now

> it is causing us to awaken from our dream of lonely isolation so we may rejoin the great community of life. (1992)

What is miraculous about this story, according to Swimme, is that humanity now has the capacity to contemplate the events. He wrote,

> The discovery of the birthplace of the cosmos, then, is the discovery of the story that has been present from the beginning. The universe's primordial origin has been here with us for millions of years. It showered us from all directions as we wandered the African savannas and built our mudbrick abodes along the Nile. Our own generation is simply the one to emerge at the time when human consciousness has become subtle enough and complex enough to awaken to what the universe has been telling us from the beginning. (Swimme, 1996, p. 66)

What does this kind of information offer to a child--like my son--who wondered about the significance of his own life in a distant region of the universe, in an average sized galaxy as the Milky Way, on the little blue planet Earth? Rogin posed the questions, "Why out of stardust has this come to be? Why birdsong? Why green? ...Why the oceans and their billions of lifeforms?" (Rogin, 1992). Swimme offered,

> The consciousness that learns it is at the origin point of the universe is itself an origin of the universe. The awareness that bubbles up each moment that we identify as ourselves is rooted in the originating activity of the universe. We are all of us arising together at the center of the cosmos. (as cited by Rogin, 1992 p. 112)

The story of the Great Flaring Forth is meant to set the context for all other learning, and perhaps most importantly, that everything in the known Universe is connected through our common origin (Lillard, 2007, pp. 130-131). Swimme offered the possibility for "a new identity of ourselves as cosmological beings--everyone is part of this, everything is part of this....no matter what being we're talking about on the planet, we are related. We are the Universe in the form of a human. (Rogin, 1992). The concept of connectivity throughout the Universe supports learning in living systems, in which each part is connected to the whole and affects the whole. It

may also aid children, like my son, to move away from the "lonely isolation" and find meaning, place, and purpose in the Earth community. According to Lillard, this is what Montessori sought through Cosmic Education (2005/2007, p. 130). A view of the history of life, in the form of a timeline on Earth, could further deepen the connection of a child to their place in the greater whole.

The Timeline of Life on Earth

The second Great Lesson in a Montessori elementary classroom, often called "The Timeline of Life," shares the story of developments on Earth "from the earliest one-celled organism to mammals" (2005/2007, pp.132-133). A great variety of living forms may be included in the Timeline of Life, with the appearance of humans near the end, which may cause children to "marvel at what an extremely short amount of time we have been here, compared to other life forms" (2005/2007, p. 133).

In *Education for Human Development*, Montessori wrote about the contribution of tiny organisms in the sea, calcareous nannoplankton, which incorporate carbon dioxide into their shells. When these unicellular organisms die, they sink to the ocean floor and form layers of limestone and chalk, thus fixing the carbon in the depths of the oceanic floors and aiding the maintenance of the Earth atmosphere (Scotchmoor, 2003). According to the *NASA Science: Earth: Carbon Cycle* webpage, "48% of the carbon emitted to the atmosphere by fossil fuel burning is sequestered into the ocean" (NASA science: earth, 2010). Montessori described the plankton,

> The tiny protozoa had a thirst so unquenchable that they could swallow incredible quantities of water-proportionately to their size. It was as if a man should drink two cubic feet a second, without rest for his whole life-and thus they filtered the water by passing it through their bodies, taking from it the salts to transform into their own

> structure, and giving back the water. Moreover, each one of them could produce in ten days a million reproductions of himself, so they made a formidable army of workers, and on dying each dropped its body as a solid particles of calcium to add to the earth around the coastline. (1948/2007, p. 24)

The dynamic, personalized story of these tiny creatures may be a way to bring interest that children appreciate, while shedding light on the importance of this seemingly insignificant organism. Without carbon fixers in the ocean, the atmosphere on Earth would not be able to support life. Montessori's description of the valiant efforts of the nannoplankton could inspire admiration for the unconscious contribution to life these little creatures make. As though giving voice to the nannoplankton, Montessori proclaimed that carbon "will serve us for food, and even when we die we shall not throw back the calcium, for we shall have consumed and transformed it" (1948/2007, p. 24).

Through imagination, the Story of Life on Earth is given to create a context of shared destiny and inspire interest in all members of the Earth community, both human and non-human.

It is in this context of mutual contribution to the whole of life on Earth, as a singular, living organism--a living system--that the third Great Story, the Coming of Humans is given.

Three More Great Lessons

The last three lessons include the Coming of Humans, Communicating in Signs, and the Story of Numerals. Each of these lessons is designed to further deepen the context of the child's understanding of his or her own particular place in time and space. The Coming of Humans begins with the evolutionary changes that made human life possible, in particular the characteristics that make humans unique. Examples of unique qualities of humans include our "unusual minds, our capacity to love, and the human hand, which can fashion and make

things" (Lillard, 2005/2007, p. 133). Children experience how different cultures have found ways to provide themselves with food, shelter, clothing, and later, defense and transportation (2005/2007, p. 133).

The lesson Communicating in Signs goes back four million years to the first cave paintings, when humans found tools and dye to record experiences in the rock. The development of pictographic writing, such as with the ancient hieroglyphs of Egyptians, is presented. As the need to communicate with other cultures arose, the Egyptians developed symbols based on sounds, which gave rise to writing. Different types of writing implements and media are discussed, such as the clay tablets of the Sumerians and the papyrus of the Egyptians. Pictorial representations of different systems of symbols help to aid the child in this lesson. Using the development of language to discuss ancient civilizations, culture, and trade gives a historical context to language and its uses throughout history (2005/2007, pp. 133-134). Montessori wrote,

> We write and read, and the child can be taught who invented writing and the instruments wherewith we write, how printing came and books became so numerous. Every achievement has come by the sacrifice of someone now dead. Every map speaks eloquently of the work of explorers and pioneers, who underwent hardships and trials to find new places, rivers and lakes, and to make the world greater and richer for our dwelling. (1948/2007, pp. 17-18)

The last of the five lessons, The Story of Numerals, speaks to how ancient civilizations kept track of records and that the simple way of doing this was by combining small numbers, such as one and two. When there was a need to keep track of many items--such as a large store of grain to be sold—mathematical systems were developed by the ancient cultures. Romans used a simple additive system, Hindus invented the zero, and Mayans developed a mathematical system based on decimals. Like the other Great Lessons, the intention is to present to the child

context for what has come before and provide inspiration for further investigation (Lillard, 2007, p. 134).

In *To Educate the Human Potential*, Montessori offered,

> Let us in education always call the attention of children to the hosts of men and women who are hidden from the light of fame, so kindling a love of humanity; not the vague and anaemic sentiment preached today as brotherhood, nor the political sentiment that the working classes should be redeemed and uplifted. What is most wanted is no patronizing charity for humanity, but a reverent consciousness of its dignity and worth. (1948/2007, p. 18)

Taken as a whole, the Five Great Lessons provide a broad, overarching context to life on Earth, in all its specificity, complexity, grandeur, and beauty. In *The Great Work,* Berry wrote,

> In reality there is a single integral community of the Earth that includes all its component members whether human or other than human. In this community every being has its own role to fulfill its own dignity, its inner spontaneity. Every being has its own voice. Every being declares itself to the entire universe. Every being enters into communion with other beings. This capacity for relatedness, for presence to other beings, for spontaneity in action, is a capacity possessed by every mode of being throughout the entire universe. (1999, p. 4)

Montessori posed questions in the *Formation of Man* (1955/1989) that resounded with the questions my son and I asked and that I have sought, through my own experiences, to answer for many years. For me, the answer to the first question, "What am I?" may be found in the Universe itself, which may be defined as "the totality of everything that exists," (Webster, 2010) and includes "all matter and energy, the planets, stars, galaxies, and the contents of intergalactic space"(American, 2010). Perhaps this context is large enough to illustrate the connectedness of all life and all living systems.

Living Systems

Learning in living systems, especially outdoors, may be helpful in creating the context of the connectedness that Berry wrote about. Describing systems thinking, Capra (1997) wrote about living systems "in terms of connectedness, relationships, and context… these properties are destroyed when the system is dissected, either physically or theoretically, into isolated elements" (p. 29). Further, Capra described living systems as a continuously evolving environment based on the changing nature of individual components:

> A living system is a multiply interconnected network whose components are constantly changing, being transformed and replaced by other components. There is great fluidity and flexibility in the network, which allows the system to respond to disturbances, or "stimuli," from the environment in a very special way. Certain disturbances trigger specific structural changes—in other words, changes in the connectivity throughout the network. This is a distributive phenomenon. The entire network responds to a selected disturbance by rearranging its patterns of connectivity. (1997, p. 268)

Education, whether outdoors, in a garden, or in the classroom integrates the context of living systems. In any classroom environment, the individual components may consist of adults, children, materials, light, plants, and even an occasional spider or ant. The specific organization of the classroom is determined by individual personalities, materials offered, the weather, and many other factors. Therefore, each classroom will function and feel differently from any other classroom at any given time--and this is encouraged. Montessori classrooms are often intentionally prepared to serve the needs of the individuals and usually rely less on generalized lessons and activities for the whole group.

It is also recognized in many Montessori classrooms that the organizational pattern on any given day could be changed by an outside stimulus, such as the appearance of an ant marching across the floor or a spider crawling on the wall. It may be, as I have observed many times, that such an event changes the whole environment of the classroom as the children and adults observe and interact with the insect. In a Montessori classroom, it may be regarded as a welcome disturbance in the network. This point is referred to by Briggs and Peat as a bifurcation point, which marks a random fluctuation that becomes amplified by feedback loops (1999, pp. 14-15). A bifurcation point may lead to either chaos or a new reorganized level of order.

In the classroom, that scenario might play out as such: A child excitedly points out that an ant has entered the classroom, creating a bifurcation point. That random fluctuation becomes amplified when other children gather around. It may be that an adult's response to the situation aids in the amplification of this bifurcation. A quick and spontaneous response could lead towards higher complexity and order with an impromptu lesson. Such actions may lead to naming the insect, describing its habitat, pointing out a material about the parts of an ant, or simply supplying a magnifying glass. This reaction to a bifurcation point may create the conditions for the spontaneous event to transform into a meaningful learning experience. In a traditional classroom that cannot allow for fluctuations, I imagine it would sound like "squish."

In some more traditional environments, this kind of event may be seen as an intrusion to be removed from the environment as quickly as possible. It may not be possible, within the organizational framework of the school or classroom to allow for disturbances in the system to shift the focus of the work at hand. For example, many New Mexico classrooms in public schools have a mandatory ninety-minute reading block in the morning. Each child, in each class,

participates in this reading block each morning (NMPED, 2012). If an ant were to appear in the classroom during this time, it may be unacceptable for a spontaneous lesson on insects to happen.

If spontaneous disturbances are not welcome in a classroom, the potential interest and learning in those moments may be lost. Since living systems operate in unpredictable ways, one might expect disturbances and fluctuations to be common events. Small intrusions from the natural world are likely common occurrences in classrooms of every kind. The difference, perhaps, is the response to disturbances. Montessori environments appear to be particularly well-prepared for spontaneous disturbance. Designing environments to adapt to those events appear to be a challenge in public education; however, an environment designed to capitalize on a bifurcation point mimics the autopoietic way of most living systems. Montessori education appears to accommodate for such an environment.

Montessori classrooms may be seen as operating as living systems in their organizational structure and response to bifurcations, connections between individuals, and autopoietic motion. Montessori classrooms may also specifically support environmental education, learning in outdoor environments, and ecology. Capra explained that systems thinking is also "'contextual' thinking; and since explaining things in terms of their context means explaining them in terms of their environment, we can also say that all systems thinking is environmental thinking" (1997, p. 37).

If Capra's assertion is accepted, then it follows that Montessori classrooms may set the context of environmental classrooms by nature, without any additional emphasis on learning in the environment, outdoor learning experiences, or other current models that have been developed

to address the topic of learning in the outdoors. To me, learning in the outdoors may be seen not only for the importance of contact with nature, but also for the experiences of living systems themselves--the chaos, the spontaneous order, the freedom, and the context of connectivity with all of life. Perhaps the very way that information is made available may be seen as equally important to the content of what is presented.

Based on the evidence presented it is my assertion that much of Montessori education already contains the processes and patterns of learning in living systems as well as the structure to support such learning. To design an outdoors Montessori classroom or school that is specifically oriented towards learning in living systems might produce a truly impactful environment for children, which may in turn support a shift for humanity. It has been my dream and goal to create Montessori environments that focus on and also operate as living systems. For my practicum work at TIES, I have experimented with these ideas in very different settings, La Tierra and Madrasat Ardh al Amel.

Chapter 6: Journey through a Montessori learning practicum- La Tierra and Madrasat Ardh al Amel

Process, Pattern, and Structure

During my time in the TIES program, I have worked on creating two new schools located in different continents and hemispheres, an experience I have come to view as paradoxical. One school is public; the other private. One school is focused on the arts; the other restricts expression through the arts. One school is secular and the other religious. Paradoxes seemed abundant in the work that I was engaged in, not only in the schools, but also through the

reflection of my own patterns of thought. I have come to view my practicum work through the lens of living systems. Capra identified three components of living systems associated with the Santiago theory of cognition that I have used to frame my practicum at La Tierra and MAA. He wrote,

> In terms of our three key criteria of living systems—structure, pattern, and process—we can say that the life process consists of all activities involved in the continual embodiment of the system's (autopoietic) pattern of organization in a physical (dissipative) structure. (1996, p. 267)

The Santiago theory, closely associated with Varela and Maturana's autopoiesis, offers that cognition is "the process of knowing" (1996, p. 267) and is described in terms of "an organism's interactions with its environment" (1996, p. 267). Therefore, process, can be described as cognitive phenomena, which relates to structure.

Structural changes to the environment occur continuously through interactions of components or individuals in the system. Therefore, the structure of a living system is always changing in relationship to process. Finally, pattern is the element that was studied by cyberneticists to aid in describing the properties of organized systems. Cyberneticists looked at "patterns of communication and control--the patterns of circular causality underlying the feedback concept--and in doing so were the first to clearly distinguish the pattern of organization of a system from its physical structure" (as cited by Capra, year, p. 157).

Patterns of communication may include bifurcation points that become amplified—such as with the excitement of children around an ant in the classroom. Careful observation of how communication and bifurcation points become amplified may be useful for adult guides who

wish to reinforce patterns that support learning in living systems. Bohm suggested that much of human communication comes from thoughts that are collective or recycled. He wrote,

> ...thought pervades us. It's similar to a virus--somehow this is a disease of thought--the more computers, radio, and television we have, the faster it spreads...it's spreading like a virus and each one of us is nourishing that virus. (Bohm, 1996, p. 58)

Bohm further described that thoughts, which may not originate with ourselves, become intertwined with perception and experience, or cognition, and warns that "when presentation becomes "fact" independent of thought, then thought begins to prove itself, creating "facts" that are not really true. Most of our representations arise collectively, which gives them greater power" (1996, p. 58). To begin to create a pattern that is then reflective of living systems, one may need to look at the common representations that arise, to inquire into their source, and to consider what Bohm called "suspension" or "proprioception" or "self awareness of thought" (1996, p. 91). If one begins to recognize personal patterns of thought reactions and become aware of them, but suspend those reactions, Bohm suggests that thoughts and feelings may be expended without "passing through 'me' " (1996, p. 85).

Capra gave the example of a "bicycle" to describe the difference between pattern and structure. The physical parts, when combined, comprise the structure of any given bicycle, while the totality of the bicycle represents "pattern." Different elements, such as handlebars and gears, may be used in different combinations to create the structures of different bicycles. However, the pattern of the bicycle remains.

To me, the dual and seemingly paradoxical nature of living systems have revealed themselves in both inner and outer worlds, the environments around me, and the environment within myself. Thoreau suggested "We might try our lives by a thousand simple tests; as, for

instance, that the same sun which ripens my beans illumines at once a system of earths like ours" (1863, Kindle DX version, p. 6).

I have been fortunate enough to have the opportunity of "trying my life" by many simple tests, as Thoreau suggested. My studies at TIES have always seemed focused on an internal process of observation, self-reflection, and transformation. Coursework included experimenting with the concepts of as dialogue, neurophenomenological research, and Varela's three gestures of becoming aware. These topics seem to require extensive internal reflection. Using Thoreau's metaphor, it has been much easier to travel from the West to Africa and back again, than it has been to explore the Atlantic and Pacific of myself.

Creating La Tierra Montessori School in New Mexico has been my project for over five years. The core of La Tierra has gone through numerous iterations of organization, in terms of pattern, process, and structure, yet always increases in complexity. As I sought the capacity to envision an entire school system, I was led to the M.Ed. program at TIES.

My original area of emphasis in the TIES program concerned administrative frameworks for Montessori education. I wanted to learn about what kinds of capacities and tools one needed to form an administrative perspective for founding a charter school.

As I struggled to find cohesion between school administration and outdoor learning in a theoretical way, these concepts were presented to me in the practicum. The administrative processes, policies, and approach I had developed for the administration of La Tierra were not available at Madrasat Ardh al Amel (MAA), but opportunities for learning in outdoor environments were. At some point, I realized that I was, indeed, studying the same concept from different points of view--learning in living systems--which could be experienced in the

administrative organization of a school as well as outdoor learning environments. What I have found, in fact, is that these components are intertwined through structural coupling in the environment and perhaps function best when developed as a whole, using Capra's three elements. The common thread throughout all of this work was my own journey of process, pattern, and structural coupling within environmental structure.

Structure: La Tierra Charter

Capra identified structure as the specific organization of a living system, as with a particular bicycle. In New Mexico, charter schools are largely responsible for how they will be structured, and are measured based on that structure. As founders, our goal was to ensure the school was measured, at least in part, for how we provided children with the necessities deemed important to education. The school is identified in the first page of the Educational Plan of the charter as a living system, network, or web. The charter explains:

> This network not only sets the stage for the Educational Plan and Curriculum, but for the entire organization-governance, administration, staff, students, and community. In this way, La Tierra Montessori School of the Arts and Sciences will cultivate life-long learners, critical thinkers, dreamers, and artists- who will have the capacity to address the complex, ever-changing issues of this unique time in the development of the Universe. (Boulmier-Darden, et. al, 2011, p. 31)

The identification of the school as a living system was intended to pull all the many components of the school together in a unified structure, which could then be understood and articulated to the state, parents, community, and other stakeholders.

The La Tierra charter ties student nutrition to the success of the school directly by identifying it as one of the three major goals, which the state education department will measure to determine the success of the school. Referred to as SMART goals, they are self-selected by

charter founders, but must be "specific, measurable, ambitious and attainable, realistic, and time-bound" (NMPED, 2010). Our nutrition SMART goal is as follows:

> **Goal 3:** Improve health outcomes of students, consistent with USDA health recommendations using the following strategies:
> Work with parents to develop student health goals at the beginning of each year, including bi-annual (September and May) BMI (Body Mass Index) measurements. Student health goals will be revisited mid-year to determine progress.
>
> Provide healthy snacks, including fruits and vegetables, three times per week
> **Year 1:** Provide fresh fruit and vegetable snacks, prepared by students for all students, three times per week to all students
> **Year 2:** Provide fresh fruit and vegetable snacks, prepared by students, five times per week to all students
> **Year 3:** In addition to the second year goal, begin to provide fresh fruit and vegetable snacks grown in the school garden at least once per month, prepared by the students, for all students. Standards that align curricular project work will be used to link the school garden to the classroom.
> **Year 4:** In addition to the third year goal, provide all students with one monthly meal prepared by students from either the school garden or local farms. Standards that align curricular work will link the meal with classroom learning. Engage all students in daily exercise activities for at least 30 minutes.
>
> Measurement: Logs will be maintained noting individual student goals, daily activities, and school food served and progress towards individual goals. (Boulmier-Darden, et. al, 2011, pp. 15-16)

In addition to the measurement of the school's success being directly tied to the preparation and consumption of healthy, organic food, La Tierra would support growing food in the local traditions. The following passage is an excerpt from the facilities section of the charter:

> LTMAS has identified some unique program needs that may be used in evaluating facility/planning and development of the long-term vision of the LTMAS facility. The following is a list of those elements:
>
> - Ample water source for garden/farm-preference for acequia on the property
> - Ample undeveloped space for school garden, farm, hoop houses-water and soil testing may be warranted
> - Outdoor water sources (spigots)

- Outdoor amphitheater or informal classroom area
- Naturalistic area for scientific studies-a living riparian or aquatic environment is highly desired
- Playground areas for early childhood, elementary
- Future planning for outdoor areas for Middle School (grades 7-8) (Boulmier-Darden, et. al, 2011, p. 152)

Nutrition, cooking, outdoor education, and the school garden were included in the application for the federally funded Public Charter School Planning Grant, which was awarded to La Tierra for implementation of the school.

La Tierra's visual representation was created as the "Web of Learning," which may be viewed as a pattern for learning in living systems.

Pattern: Web of Learning

The La Tierra Web of Learning may be considered a network. A network is defined as "an interconnected or interrelated chain, group or system" (Merriam-Webster, 2011). In a paper titled *The network approach: basic concepts and algorithms*, University of Stuttgart physicist Pedro Lind offered this explanation of the construction of networks, "the first thing to do when constructing a network is to know what kind of components and interactions between them are we talking about" (2007).

In the La Tierra Web, there are three main components that connect to create the "self." These three components are "body," "mind," and "spirit." In the La Tierra Web, the components of body, mind, and spirit could be viewed as opportunities for integration of experiences across disciplines.

The essential features of the three components may be regarded as symbolic representations of the physical body, the mind, and the spirit, which is defined as the "animating

or vital principle held to give life to physical organisms" (Merriam-Webster, 2011). An alternate definition for spirit could be creativity, or "having the ability to create" (World English Dictionary, 2011). Montessori Jr. explained, "If their spirit is not touched, they may comply with our demands for work; but the psychological value of their work will be restricted to a more or less mechanical learning of techniques" (1976/1992, p. 50).

Figure 13. La Tierra Web of Learning. (Boulmier-Darden, et. al, 2011).

Swimme described the relationship of network components in *Hidden Heart of the Universe* by referring to an example of the possibility of incorporating ancient and traditional Cosmology with the Cosmology of science in the post-Newtonian world. This same concept could be applied to education, such as can be found in a typical Montessori classroom. Swimme wrote,

> The aim is not to eliminate one way of knowing in favor of another; the aim in an ultimate sense is an integral understanding of the universe grounded in both the scientific empirical detail and in our primordial poetic visions of the cosmos (1996/1997, p. 77).

That empirical detail calls for a closer look at process.

Process: Preparing for La Tierra

I neither wanted to found a charter school, nor did I intend to. In fact, because of my experiences in the realm of public education as a young person, the one thing I never desired to become was a public school educator. I became involved in education by chance, but also out of a primary need to provide for my children.

Then idea of La Tierra was born in the fall of 2007. I was one of four single moms working at local Montessori schools who were experiencing similar struggles. We would chat on the playground about our shared experiences. We seemed to always feel tired and we struggled to make ends meet. We wanted to reach out to children of working class parents, like us, but we were fairly certain we did not know how to solve these issues. I suggested starting a charter school.

As the endeavor to found a charter school grew, there were personal conflicts, misunderstandings, and blow-ups around specific events that happened between children and adults. Friendships and relationships were strained and some ended. There was an effort to bring all three of the local private Montessori schools to develop a charter school together, yet personality conflicts prevented this from happening. In *On Dialogue*, Bohm wrote about communication problems such as the ones we were facing and claimed that much of the communication promoted through mass media "is a collection of trivial facts or confusion and misinformation" (1996, p. 1). Those who try to remedy the problem of communication often find themselves at odds with each other and cannot communicate. The Montessori teachers were divided over matters of philosophy and the behaviors of certain children and adults. Lines were

being drawn and there were many conflicts, both personally and professionally. These conflicts, to me, represented a pattern of communication in the group dynamic.

Pattern: La Tierra

Creating La Tierra was a personal and continual emotional roller coaster. I perceived a pattern in my own life of struggle and conflict, especially relating to education and authority. I would swing from the certainty that I was doing the right thing, to despair and hopelessness. Each person involved with the school seemed to face emotional challenges, yet much of the conflict seemed to center around how I was perceived. Within a few years, there were two of us still committed to the project. The whole project seemed doomed for failure, yet the more conflict that arose, the more determined I was to see it through. Bohm wrote about how

> If someone says, 'People of this category are bad,' and you accept that, then the representation of thought enters the presentation of perception. Once you've accepted that, it goes into implicit, tacit thought. The next moment, when you see a person of that kind, it comes up as a presentation. The 'badness' is perceived as inherent in him. It is not that you say, 'I know that somebody has told me that these people are bad, and they may be bad or they may be good. I'd better look and see.' But rather, what they 'are' is apparently right 'there.' From there on, you think about that as if it were entirely an independent fact-independent of thought. (Bohm, 1996, p. 65-66)

What I have perceived through my work at TIES is that the identity that I developed as a struggling, gifted teenager had remained with me through adulthood and that identity was being re-affirmed through my interactions with others. In this case, though it is hard for me to see, perhaps I was the bifurcation point that was being amplified. This identity, I found, was no longer serving me, the school, or my community.

The school needed a governing council that would provide oversight for the school. I did not have the political or personal connections to rally a council together. So, with great disappointment, I put the charter application away. At this time, I discovered the opportunity to

start a school in Algiers. I would find in the process of creating Madrasat Ardh al Amel (MAA) that my dream was not dying, just reorganizing. Roger Montoya, my co-founder, jumped on board in 2010 and may have been the perfect bifurcation point to pull the chaos of founding a school into order. Montoya brought fresh eyes and many new volunteers to the project and after many rebirths and iterations the charter was submitted to the state in July 2011. After reviewing the application, interviewing our team, and holding a public hearing, the New Mexico Public Education Commission voted unanimously in favor of approval in September 2011.

We tried to ensure this process at MAA in a number of ways, which follow.

Process: bringing Montessori to Madrasat Ardh al Amel

In the spring of 2010 I was contemplating the design of a trilingual Montessori school from the ground up, with limited resources and in a completely different culture. This school, Madrasat Ardh al Amel (MAA), was quite different in many respects from La Tierra. It was a privately run school, authorized by the state, and was meant to operate in concert with the Algerian curriculum, which centers on a traditional style of instruction, exams, Q'uranic studies and Arabic language. Along with the many challenges of this new school, I also had the dilemma of redefining my emphasis area in the TIES program. I was no longer composing the theoretical structure of a school, as there was an administration already in place at the school in Algiers. Because MAA is a state-approved school and follows the Algerian curriculum for grades K-8, the Montessori preschool enrolls toddlers starting at age three and lasts five or six years. The school employs teachers in each language to give lessons. I would discover complexities in the specific culture, place, and ecosystem of the school that I could not have accounted for in advance.

Structure: Madrasat Ardh al Amel

The structures of gardens in two unique places could be viewed as the difference between structures of two different bicycles. The basic elements may be similar, but the patterns may be very different. I made plans to introduce basic structural elements of school gardens at MAA, including vegetable gardens, composting, and other components I felt were necessary for learning in outdoor environments. Those conceptions would be challenged through my experiences at the school as well as the participants--parents, administrators, and children. I would find that the specific circumstances of the school would lead to very different experiences of learning in outdoor environments than what I had planned.

Because of the unique nature of MAA, there were a number of challenges in the environment. Obtaining and preparing materials in three languages, communicating and training across language and culture, and working to establish a normalized classroom with diverse children from the ages of three to six are some of those challenges. Though I searched for several months for seeds, I was never able to find any to purchase for the school. What I was not prepared for, however, were the reactions to learning in outdoor environments, which would challenge flexibility within the system of the school and culture. A general Algerian apprehension for dirt and working outside caused me to question if building a compost pile was a good choice for MAA. I found that the change in place made a great difference in the nature, scope, and significance of my project. I discovered what may be ordinary or desirable experiences for students in New Mexico cannot be presumed to be so for students in Algiers and vice versa. And so, I discovered, what could be presented to children in Algiers was really quite different from what might be presented to children in New Mexico.

In addition to the challenges the school presented, there were also a number of exciting opportunities in the "niche" of the school--especially as they related to the area of focus of my Master's project-outdoor learning environments. The grounds of the school include a large orchard, raised garden beds, as well as a cluster of 'mshimsha' fruit trees (a unique fruit that peels like a mango, but tastes like a cross between a kiwi and a citrus fruit). In many ways, it was an ideal site for outdoor learning experiences to develop, if not for cultural attitudes that made outdoor learning challenging for students, staff, and parents. A more detailed explanation of the MAA environment follows.

Pattern: The MAA Outdoor Environment

On my arrival, there was no dedicated outdoor play space at the school per se-it is a house. Students played with what was available. Grape vines seemed to make acceptable bouncing apparatus, trees are excellent climbing structures, and endless games were invented that involved plucking the leaves off rosebushes and other plants around the school. There were frequent breakages of branches and new growth in the school grounds, revealing what I perceived as a general pattern of relating to plant life as a vital component of the living system rather than a set of playthings to be discarded. I found it quite painful to observe this pattern without taking action to prepare a more appropriate environment.

Students casually discard wrappers and other trash on the school grounds daily. There seems a firm distinction between areas that are considered "civilized" (such as the marble terraces at the school) and those that are considered "uncivilized" (such as the orchard that lies beyond the terrace). The attitudes towards garbage, as well as civilized and uncivilized places, may have been reflective of patterns in cultural orientation to the outdoors.

On my first visit to the school, children were not allowed in the garden or orchard areas at all. I found myself breaking that rule quite abruptly one morning, as I escorted a very distraught young student into the garden to calm him and connect with nature. This student happened to be autistic and frequently struggled with being around groups of children. I escorted my friend to the garden, thinking that he would find comfort and "grounding" there. Perhaps, I thought, he might put his hands in the earth itself for comfort. I brought him to a place where we could pull weeds together and pulled out a yellow flowered plant and showed my student the roots. I was shocked to discover that my student was actually very afraid of the roots and of the dirt around them.

At first, I thought this to be a peculiarity of this boy's experience with autism, but I soon observed that many of the children appeared to share a similar aversion to the dirt. This was quite different from my observations of children in New Mexico, who often deposited shoes full of sand and dirt onto the entry rooms of the Montessori schools where I worked. I thought deeply about the process of relationship to the natural world and the impact on children's attitudes towards being in outdoor environments.

Process: Outdoor Learning at MAA

As I worked on my practicum involving outdoor learning, I noticed some school policies had shifted. The students were now allowed in the gardens and were beginning to become comfortable with pulling weeds from the base. There appeared to be a commonly shared pleasure in watching carefully for the long, mysterious roots to emerge from within the soil. On any given day, there may have been three or four classes sitting on simple woven rugs in the orchard or holding class under the mshimshas while munching fruit from the trees for their work

period. There was a "garden crew" who raked and cleaned beds and plucked trash to put in plastic bags (which were often absently discarded back into the gardens). Nevertheless, there were structural changes happening in the system as the students and I were coupled to our environment.

In late spring, when the mshimshas were ripening, I was the spontaneous organizer of a spontaneous all-school mshimsha harvest and tasting bonanza. It was a great joy to watch the students climb the slender branches carefully, search for the ripe fruit, select a yellow-orange mshimsha, and then come down to show their prize before making way for the next student. After the eating was done, though, the terrace was covered with peels and seeds.

In addition to the work in the outdoor environment, there were also developments inside the classroom. A material that was prominent in the classroom was the Montessori botany cards, which were depicted in three languages. These colored picture and word cards illustrate and name the parts of a flower, leaf, and tree. Many of the students in my classroom used these cards. When the local wildflowers exploded in April, students brought flowers to the classroom daily and proceeded to pull a few apart to match to the 'parts of a flower' cards.

The most commonly picked flower was "oxalis," a runner-shoot plant, which is considered a very unwelcome guest in greenhouses in the United States (due to its prolific nature). I felt repulsed by this plant at first very much, because of my work experience in greenhouses. But to the children, it was a beautiful flower that they would bring in huge bunches. The oxalis flowers look very much like the red flowers in the Montessori cards and have been used numerous times in my classroom for that material. I found that I could suspend the reaction of repulsion to the oxalis flowers and view them in a new light. This suspension

may have opened an opportunity for the students to use the flowers extensively with the Montessori cards, pulling them apart and matching them, arranging them in bouquets, and finding many other uses in the classroom for these colorful flowers.

Figure 14. Montessori "parts of a flower" cards in Arabic, French and English (Boulmier-Darden, 2012).

Figure 15. "Oxalis Strictus flower"

The plans that I had made for planting little beds of carrots and vegetables have proven to be New Mexico niche ideas, not Algiers niche ideas. I considered the change in location and culture as I prepared for my neurophenomenological research and the lesson for my observation.

Preparation for Research

As a part of the research and creativity module in the TIES curriculum, I participated in neurophenomenological research. To set the stage for the research, each of us observed in a public setting, then a natural phenomena, and finally a living being. Following these observations, we turned inward to have a view into ourselves, noticing patterns of thought, emotion, and reaction that may influence the act of observation. Finally, TIES students were asked to give a lesson pertaining to their specific area of study and videotape the lesson. After taping our lesson, my colleagues and I viewed the videos twice-one from the first person

perspective of what was happening, and the second time from the point of view of the students- or third person perspective.

Neurophenomenology is a framework for self-observation developed by Francisco Varela, and may be seen as a way to experience autopoiesis. In describing the research project, faculty Marsha Morgan offered, "We understand autopoiesis as meaning: self-creation from the environment. In a largest sense it can be compared to an understanding of the intersection of ecosystems as they influence one another" (Morgan, 2012). Morgan continued, "From this large scope we can observe autopoiesis as an expression of our connectedness. This form of research examines mutual involvement"(Morgan, 2012). Since each participant or component of a living system has an individual perspective and experience, it may be useful to analyze experience from more than one perspective. Through the process of observation from both first and third-person perspectives, one may be able to gain insight into the creation of mutual involvement and connectivity of a classroom, its participants, and the larger environment.

Because my emphasis area focused on learning in living systems, I was interested in not only using the natural environment as a context, but also gaining insight into how the environment of self and others in the classroom responded and changed over time. As I experienced the coupling of the environment and its participants, I tried to practice flexibility in regards to structural changes in the living system of the classroom, including changes in my own structural coupling.

The lesson I planned for my research observations was matching natural leaves to the leaf forms in the Montessori Leaf Cabinet. I envisioned a whole-class presentation of this lesson, though I almost never present materials in that way. However, I resisted giving this lesson as a

planned whole-group activity and preferred to wait for the inspiration to naturally bubble up from the children. This did not appear to be an easy provocation to me, having observed the various peculiarities to the natural world that my Algerian students appeared to have.

It is a practice in some Montessori classrooms to approach unit studies by having the contextual experience first, followed by a study of the elements found within the context afterwards. To honor the Montessori approach then, an experiential outing was needed to set the stage for a spontaneous investigation into botanical life.

An all-school field trip was planned for a visit to the Jardin D'essai, the national botanical gardens located in downtown Algiers. The Jardin D'essai is quite large and juxtaposes the formal garden elements of European design and the wildness of the "African jungle." A central axis of wide walkways, punctuated by sculptural pieces and a series of water fountains, is surrounded by masses of colorful flowering plants and formal hedges. This central axis creates a grand walkway with views of the bay of Algiers and the Mediterranean Sea below and the heart of Algiers and the National Monument above.

Figure 16. The axial center at Jardin D'essai, Algiers, Algeria (Boulmier-Darden, 2012).

The Jardin D'essai, I thought, would provide the necessary inspiration and provocation for the lesson I wished to give. It was with great excitement that I prepared for the trip. However, as our field trip unfolded, it became clear that the main interest of the children was the small zoo housed in the Jardin D'essai. The children appeared to want to rush through the garden so that they might finally get to the zoo and view what seemed to me a collection of unhappy animals. I guessed that the students would return to school the next day happy and excited about zebras, lions, and hyenas, not two-foot tropical leaves. My expectation proved true.

When the class arrived at school the following day, there seemed a great buzz about all the animals. This might have explained the unusually active gate climbing amidst the sounds of monkeys as well as the roars, pouncing, and scratching that took place on the classroom rug and other adventurous displays that day. I elected to leave the leaf cabinet alone, choosing instead a set of African animal figurines, which were enthusiastically received. I was rather discouraged about my hope of sharing the joys of botanical life with the Montessori class at MAA.

Figure 17. Mature Ficus Tree, Jardin D'essai, Algiers, Algeria (Boulmier-Darden, 2012).

I determined to wait and watch for signs of interest. Another day came and went and then another. I was dreading giving this lesson, not wanting to impose something disinteresting on the students for my own project. I wondered, disparagingly, if an experience of the Jardin D'essai could not inspire a love of the natural world, what could? Perhaps I was choosing a topic of inquiry that was doomed for a bland reception. After almost a week went by, I knew I had to film a lesson and get the assignment done. I packed my video camera and trudged off to school through the olive groves and wildflowers, now bursting with life.

The morning of my observation was chaotic and unsettled. The usual morning circle time (which many Montessori classes feature) might have been the right time to give the lesson. However, at Madrasat Ardh al Amel, the morning circle is time to recite the Q'uran with the Arabic teacher, who enthusiastically keeps the children sitting for nearly an hour. After Q'uran the students eat snack and then slowly move into a work period. I did not want to gather the whole class after sitting for so long, yet could not seem to find a way to offer the lesson to a small group.

My classroom, like many, has a few boys who regularly choose to disrupt others instead of doing work. On this particular day, I decided to keep two of these boys in during outdoor recess. We got into a triangular configuration in close proximity so that I could aid them in completing the work they had chosen. Neither of the boys was pleased with me and complained loudly about staying in. As I sat watching them, I considered how grumpy I felt and how often that feeling seems to occur for me.

I had been struggling with the limits of patience and kindness for some time and starting a new classroom had exacerbated the difficulty. I had the feeling of wanting to transform, but

felt stuck. Actually, I had become so concerned with the lack of internal progress being made, that I was considering whether or not I should be a Montessori teacher at all. I was deeply troubled by this. I determined that it would be helpful to see myself on video with two unhappy boys, to observe myself in all my grumpiness, before considering what changes I might be able to make in order to gain patience, understanding, forgiveness, and kindness. I followed through with my observations and lesson plan.

Observations on Matching Leaves to the Montessori Leaf Cabinet

I set up the camera and put it on the shelf in clear view of the two boys and myself. I began to go back and forth between the boys-offering assistance and redirection in a very firm way. As I did this, I noticed the leaf cabinet between the two boys. I began to pull out the drawers and place them on a nearby empty shelf. Just as I was finishing this, a child from class came skipping in through the French doors (which are not normally open) and handed me a leaf! It was a roundish leaf. Astonished, I took the leaf and held it next to the leaf shapes that were right next to me. I was looking for a match. One boy found the leaf shape he thought matched the best and we placed it there.

I asked the boy if he would go look for a different leaf that we could match. He soon returned with a few interesting leaves. Within minutes a dozen or so students surrounded me, all with leaves in their hands and all looking for a leaf shape that matched. By the end of recess, the whole class was in the room and there was a large pile of leaves by each shape. Some of the children found leaves that were almost exact matches to the leaf shape, size, and color! The two boys I had placed at tables had quickly finished their work so that they could go searching for leaves as well. I had almost completely forgotten about them! I was dumbfounded.

A simple, spontaneous act by one child in a prepared environment seemed to cause a spark of interest that spread to the whole class and resulted in a beautiful expression of learning and excitement! This situation may be a good illustration of structural coupling in action. The environment in this case having the leaf cabinet drawers out and available on shelves, was coupled with a child--who walked in carrying a leaf--created a spontaneous experience that may have not otherwise happened.

The challenge of redirecting two stubborn students towards work dissolved on its own. This happened irrespective of my doubt, discouragement, and hesitance. As a result, I was exhilarated, refreshed, and pleased with the "lesson" that I had prepared. It could not have gone better, to me. On a deeper level, I felt reminded of the simple but powerful influence that Montessori's materials may have to create such sparks. Further, the experience of this lesson created the conditions for me to examine how easily one may move from doubt and despair towards hope and joy.

When I viewed the video of my lesson from the third-person perspective, I noticed that the agitation of the students I had kept inside to do work seemed to disappear when my attention from them shifted towards the spontaneous leaf matching lesson. An air of comfort and relief seemed to come over these students. The two boys seemed to look towards me for either a punishment or invitation to join in the activity of matching leaves. One of the boys came to me seeking confirmation to join the others, and when that was given, he happily went out into the environment looking for leaves, returning several times with new variations. He seemed relaxed and happy. The other boy followed out on the heels of the first, and also seemed satisfied. There was a moment on his return, when he looked towards me fearfully as he offered his leaves, not

having asked for permission to go out. When the second boy's leaves were happily accepted along with the others, he too seemed to settle into a satisfied and engaged orientation towards leaf matching.

I noticed some of the other children peering at the two boys who had stayed in with me, seeming to look for signs of apprehension or discomfort. These children and their obvious excitement over the work seemed to have a direct effect on the others, almost soothing them as they worked together.

In observing my own experience, I noticed that I seemed to convey outwardly the frustration and irritation I was feeling internally. My movements were stiff, and the words I used also seemed to demonstrate an effort at restraint. I was working very hard on preventing outward expressions of anger, yet the feeling was very much evident in the way I moved in the environment. This seemed to dissipate almost instantaneously as the spontaneous action of one child brought about the lesson I had been so anxious about giving. Near the end of the video, I observed myself moving around much more freely, laughing and celebrating with the children, and regarding slight misbehaviors in a much more tolerant and relaxed way.

Reflecting back on the experience, I was reminded of the strategies suggested for use in "becoming aware." From an interview with Francisco Varela in 2000, TIES students were directed to be aware of suspension, redirection, and letting go. Referring to suspension, Varela suggested that we "have this uncanny possibility of actually removing ourselves from the habitual stream and taking a break" (Scharmer, 2000). The habitual pattern that I may have observed in myself was a feeling of irritation and frustration about a difficult situation. I recognized that this is a generalized feeling that occurs quite frequently for me. In the particular

situation at hand, I was aware of the video camera being turned on and therefore made extra efforts to appear calm, kind, and firm with the two boys while we worked. Yet inside, I was quite agitated and nervous about what I would see myself doing in the video. Without realizing exactly, my anxiety about the video and the two boys was "suspended" by the appearance of the child with a leaf.

Varela had said,

> …suspension will lead to very early emerging events, contents, patterns, gestures, whatever. Then you can actually redirect your attention to them. That's where the new is. So the suspension creates a space, the new comes up, and then you can redirect. Redirection is a specific gesture. (as cited in Scharmer, 2000)

Perhaps it was just the act of recognizing a child carrying a leaf that was the catalyst for suspension in that moment-a suspension that naturally led to redirection in this case. The leaf was in the child's hand and the leaf cabinet drawers were out. It seemed as though the situation were set up to create the conditions for a productive neurophenomenological experience for me. Once the catalyst for redirection was there, letting go was easy.

The third "gesture of becoming aware," according to Varela, is letting go. He said, "Life is constantly in this process of re-accommodation and therefore this kind of cycle is at the very core of what life is all about" (as cited by Scharmer, 2000). When my attention shifted from working with two resistant boys to organizing leaves, there was a kind of reorganization in my mind of what was happening, and this is where letting go may have occurred. The flow of work happening spontaneously just seemed to have taken over and the worries and anxiety that I had been feeling melted away.

As I reviewed the videos later, I noticed that the excitement of work around the leaf cabinet created a relaxed atmosphere-perhaps a field (which I will expand on in the next

chapter)-in which the boys turned their attention to the work in front of them, saw what needed to be done, and then quickly and quietly completed the work and put it away. They appeared to have forgotten about the tension roused by their work habits.

Reflecting on Montessori's suggestion about redirection-that uncontrolled behavior in the classroom is almost always taken care of by engaging in work-I reflected that the same is true for me. Perhaps when I am feeling uncontrolled by my emotions, the answer may be to redirect my own attention towards meaningful work. In this way, I come to more fully realize how the students and I are equals in the classroom; each person, regardless of age, is a child on a journey towards his or her own inner vocation. Creating educational settings to support this kind of equality is the focus of Chapter 7.

Chapter 7: Educational organizations that support learning in living systems

Given the concerns about the Earth's environment and the threats to the landscapes of children as outlined in this paper, creating educational settings and opportunities for learning in living systems today may support a growing desire for a more balanced relationship between humans and the Earth. Montessori classrooms appear to be a likely way of integrating learning that is modeled after natural systems.

Ensuring that planning from an administrative level supports the science and study of living systems may be a vital component of ensuring integrated learning. Articulation of internal processes and shared vision are appropriate tools for supporting such educational settings.

Many modern schools are moving towards integrating outdoor learning in their schools, with such components as school gardens and student prepared lunches ("Dispatch from New,"

2012). Some schools seem integrate outdoor elements more easily than others. One may wonder about how closely those schools operate *as* living systems from an organizational perspective. I perceive schools that operate using mechanistic models of organization may struggle with maintaining order when in the context of nature. Cultivating flexibility to make room for spontaneous events in living systems may be challenging in mechanistic systems. Krishnamurti asserted, "If we are unaware, mechanical in our attitudes and actions, we fight shy of any demand upon us that is disturbing and that cannot be met by an automatic response, and this is one of our major difficulties in education" (1953, p. 27).

Wheatley focuses on new possibilities for organizations to flourish in the light of new science such as quantum physics, chaos theory, and wave-particle theory--the science of living systems. Margaret Wheatley proposed that "what works for nature probably also works for human organizations" (1999, p. 162). Wheatley suggested a common and clear vision might be an essential component in building healthy fields of organization.

Common Vision and Fields

Wheatley described the new scientific study of "fields" in relation to organizations. Based on the work of Frank Wilczek and Betsy Devine, the study of fields suggests that the entire universe is made of real but invisible fields through which experience and interactions occur (1999, p. 50). Fields may be thought of as analogous to the water in which fish are observed swimming. If one was not aware of the water and observed a fish swimming close to another and the second fish's course change, one may think that the first fish caused this reaction. Yet, in actuality, it is the water in which the fish move that causes the change (Wheatley, 1999, pp. 51-52).

If one thinks of organizational vision as a field, then the experience of what happens in that organization is guided by this field's context. It is for this reason, Wheatley wrote, that organizational vision must be clear and shared with constituent members (1999, p. 53). The author encouraged readers to discover what a field contains by looking at what kinds of messages are being communicated in an organization. Wheatley suggested that

> …when only contradictions float through the ethers, this invisible incongruity becomes visible as troubling behaviors. Because there is no agreement, there are more arguments, more competition, more power plays. People say one thing and mean another. Nobody trusts anybody. The organization changes direction frequently and can't find its way. (1999, p. 54)

For a school to operate and manage itself with a clear and consistent field, then, it may be essential to establish organizational clarity and vision that is consistently communicated and offered by all of its members.

Again, on fields, Wheatley offered,

> If vision is a field, think about what we could do differently to use its formative influence. We would start by recognizing that in creating a vision, we are creating a power, not a place, an influence, not a destination. This field metaphor would help us understand that we need congruency in the air, visionary messages by visionary behaviors. We also would know that vision must permeate through the entire organization as a vital influence on the behavior of all employees. And we would understand their disintegrating effects on what we dream to accomplish. We would become an organization of integrity, where our words would be seen and not just heard (1999, p. 56)

The clarity of organizational fields may be cultivated through participative management in the school structure.

Cultivation of Participative Management

Wheatley suggested that for decades, "there has been a growing chorus of research and practice that sings the praises of participative management" and that "Everywhere in the new

sciences, in living systems theory, quantum physics, chaos and complexity theory, we observe life's dependence on participation (2006, p. 163). All life participates in the creation of itself, insisting on the freedom to self-determine" (2006, p. 163).

The concept of self-determination in school management appears to be shared by Krishnamurti. He suggested that fear prevents real freedom: if a teacher was inwardly afraid, "she (he) will pass that fear onto her (his) students, although its contamination may not be immediately seen" (1953/1981, p. 105). In order to prevent this, Krishnamurti suggests,

> …the educator [herself/himself] must be aware of the implications and the full significance of freedom. Example and compulsion in any form do not help to bring about freedom, and it is only in freedom that there can be self-discovery and insight. (1953/1981, p. 105)

Creating schools that encourage self-determination may be quite challenging. Wheatley wrote, "Of course, such freedom is exactly what we try to prevent. We have no desire to let information roam about promiscuously, procreating where it will, creating chaos. Management's task is to enforce control, to keep information contained" (1999, p. 97). On modern organizations, Wheatley ironically suggested, "The last thing we need is information running loose in our organizations" (1999, p. 97). However, she offered, "if information is to function as a source of organizational vitality, we must abandon our dark cloaks of control and trust in its need for free movement, even in our own organizations" (Wheatley, 1999, p. 97). Challenging as this idea may be for schools, if they wish to mimic living systems, this free flow of information may be essential.

Encouraging free, authentic communication may start with the administration or principal, whose leadership will set the tone for the entire organization. Krishnamurti wrote,

> No teacher should be afraid of the head-master, nor should the head-master feel intimidated by the older teachers. Happy agreement is possible only when there is a feeling of absolute equality among all. It is essential that this feeling of equality prevail in the right kind of school, for there can be real co-operation only if the sense of superiority and its opposite are non-existent. If there is mutual trust, any difficulty or misunderstanding will not just be brushed aside, but will be faced, and confidence restored. (1953, p. 90)

Finding support for administrative needs may be critical to participative management.

Administrative Support

An administrator who embraces collaborative work may demonstrate to staff the equality that the school strives to cultivate. Wheatley wrote "if we believe that responsible leaders must have their hands into everything, controlling every decision, person, and moment, then we cannot hope for anything except what we already have-a treadmill of frantic efforts that end up destroying our individual and collective vitality" (1999, p. 25).

In evaluating organization capacity for cultivating equality and vitality, Wheatley suggested asking the following questions:

> Do people know how to listen to each other? To work well with diverse members? Do people have free access to one another throughout the organization? Are they trusted with open information? Do organizational values bring them together or keep them apart? Is collaboration truly honored? Can people speak truthfully to one another? (1999, p. 40)

This type of collaborative flow of information and honesty may be a different approach from the generally accepted hierarchical organizational models within which many schools operate. When not cultivated, Wheatley offered that leaders might "exhibit a flagrant disregard for people and their abilities", ultimately causing "people (to) use their creativity to work against these leaders, or in spite of them" (p. 40). However, taking the time to create organizational charts of interconnected systems may aid staff and administration to visualize and cultivate

equality. To create a clear organizational structure for the principal of La Tierra, the effort to communicate equality is a process I have scrutinized during my TIES practicum.

Organizational Structure

While writing the charter for La Tierra, Montoya and I desired to maintain a web-like, interconnected structure in the organizational chart, yet had the responsibility to the state to demonstrate a clear chain of command. The following figure illustrates the chart that was submitted in the charter application.

Figure 18. La Tierra Organizational Chart, Charter School Application (Boulmier-Darden et. al., 2011).

This organizational chart was initially rejected by the state education department. Alternative charts were offered, including a traditional hierarchical model with the words "Head Learner," "Adult Learner," and the other titles, as shown below. In this chart, there are connections between the Governing Board, the Head Learner, and the Business Manager. There are lines connecting the Head Learner and Business Manager with Adult Learners or classroom teachers. The students appear to interact with only Adult Learners and Support Staff, which includes classroom co-teachers, or Co-Learners. Therefore, according to this model, students

only have contact with the Adult Learners and the Support Staff, which may be interpreted as not having access to the Head Learner. Likewise, Support Staff seem to only have connecting lines to Students. La Tierra was designed to include the Head Learner providing oversight for the student-run judicial council, interacting directly with students in problem-solving and refining school rules. Further, one would hope that Co-Learners would interact directly with Adult Learners and the Head Learner, as equal partners in creating a participative school. This chart does not depict a web of relationships. For a new teacher or employee to understand a vision of equality and participation, this chart may lack specificity about that vision.

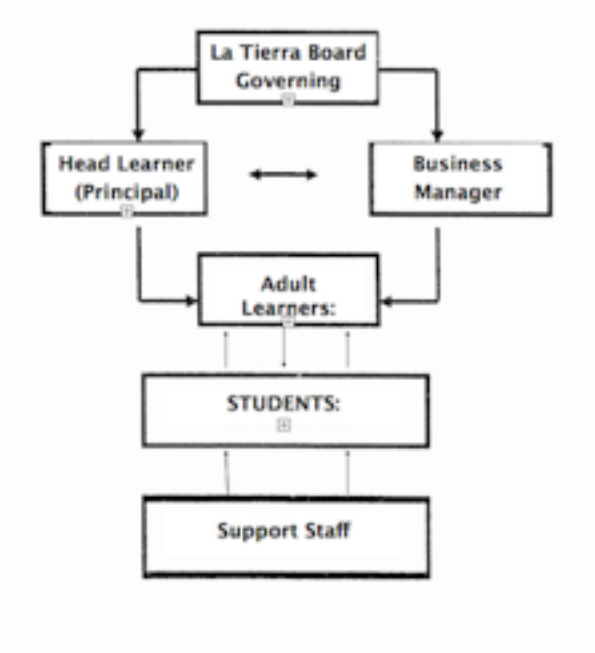


Figure 20. Proposed revision to La Tierra Organizational Chart, 2012.

In an effort to clarify the vision of interconnected relationships, I used Mind Mapping to develop a chart that both illustrates an ultimate chain of command and depicted the vision of a web. Is it worthwhile to create visual images for school structures that mirror living systems?

Figure 21. Proposed La Tierra Organizational Chart showing orientation to Living Systems (Boulmier-Darden, 2012).

It is my assertion that visual representation of equality and connectedness important for communicating to all of the component members (administrators, staff, parents, students, and community). Connecting the outdoor environment and living systems of the specific location might help communicate a vision of relatedness and commitment to place. Perhaps the images that are generated may become "visionary messages" of congruency, as Wheatley suggested, one where "words are seen" and are in line with the larger context. In this case, the goal is to create messages of interconnected relationships. I believe it is worth the effort to convey these

messages, but also incorporate new information throughout the administrative and daily life of a school.

Incorporating New Information

However a school defines its organizational structure, Wheatley encouraged circulating as much information as possible to as many individuals as possible, calling especially for information that seems "different, disconfirming, and filled with enough newness to disturb the system into wise solutions" (1999, p. 100). She described this process of integrating new information: "as information continues to proliferate and confusion grows, there comes a memorable time...when the group self-organizes, growing all that information into new, potent visions of the future" (1999, p. 105).

The inclusion of clearly defined democratic processes may be a way to aid in dialogue and the free sharing of information, as well as build the development of cooperative systems in a learning environment.

Democratic Processes

TIES faculty Philip Gang suggested the principles of democracy are based on a "conviction that people are created equal, that they have shared common interests, and that working together can actualize those interests" (1989, p. 45). He suggested that schools engage students in freedom of choice, responsibility, respect, and equality (Gang, 1989, p. 46). Further, Gang suggested that democracy should be taught experientially through participation in democratic processes (1989, pp. 52-53). Developing a school-wide approach that engages constituents in democratic processes may lead to experiences of integrated learning. Gang wrote,

> Individuals so educated, are not stuck with linear logic; they are not just focused on their own idea, their own solution, but can appreciate other points of view. This leads toward collaboration and cooperation with other human beings, which is the foundation of a democratic society. (1987, p. 53)

Defining specific structures and procedures for democratic processes in the school may be useful in the every day governance and decision-making process. In the charter of La Tierra, specific plans for the democratic process at all levels, beginning with the governing council. In addition to articulating democratic processes for the governing council, the La Tierra charter identified "judicial councils," democratic bodies whose tasks include aiding in problem solving, refining school rules and guidelines, and communicating ideas directly with staff, administration, and the governing council. The student judicial council is comprised of rotating student representatives from each classroom, a teacher, and the Head Learner, who facilitates the process. In addition to the student judicial council, democratic councils for addressing concerns of staff, parents, and community members have been included in the charter of the school (Boulmier-Darden, et.al, 2011, p. 44).

I have suggested that integrated learning environments may include opportunities for the whole child--including the mind, body and spirit--and that attention in all of these areas may lead to truly integrated learning for children. The same considerations for the environment may be viewed as valid for adults as well. As with children, adult learners and guides have different learning styles and needs. Living systems may lead to greater levels of complexity to meet the needs of individuals. A network of connections through process, pattern, and structure could create a system that serves different kinds of student and adult learners, while remaining individually flexible. Creating a context of dialogue, cooperation, and democratic processes may be valuable components of a healthy, integrated learning network.

Conclusion

I entered the TIES program to study Montessori Integrated Learning. Throughout the program, I have learned a great deal that sharpened my focus on learning in living systems. I concentrated on specific lessons or elements of learning in the natural world, which I found useful and exciting. I also discovered many valuable structural components for building curricula that may be applied to schools for learning in living systems. Insights into the nature of the universe, the new sciences, and Montessori education have broadened my views regarding education and life. The orientation to ecology and deep ecology sharpened my awareness of environmental and social concerns from many angles. My studies in New Mexico and Algiers also provided information that is meaningful about two specific environments. These two environments, though they may seem like a random pair, appear to have many similarities that could be used to build a bridge of understanding between two very different cultures. All of these experiences have been tremendously valuable in the context of my life and the work at TIES.

In addition to all of these benefits, I have found several unexpected learning experiences through the process that I feel are vitally important to learning in living systems. First and foremost of these is the experience of growth and learning in myself. Though I may have been amply prepared with information about learning in living systems, I have found it challenging to move away from a mechanistic approach and embrace the inspiration of the new sciences. Therefore, much of the journey has been internal.

I have worked for years on providing myself with an adequate education of my own design, which was more suitable than what I was offered as a child. I chose this course of study as a result of reading Thoreau and the impact his words had on my life as a frustrated teenager. In completing this master's program, I have found it necessary to go back to his words and evaluate what I have accomplished. Indeed, I have found new insights from this reading that were unexpected. Thoreau wrote,

> What does Africa-what does the West stand for? Is not our own interior white on the chart? Black though it may prove, like the coast, when discovered. Is it the source of the Nile, or the Niger, or the Mississippi, or a Northwest Passage around this continent that we would find? ...explore your own streams and oceans; explore your own higher latitudes...be a Columbus to whole new continents and worlds within you, opening new channels, not of trade, but of thought (1863, p. 243).

I did not intend to travel these great distances, from the West to Africa and back merely to study my own streams, continents, and latitudes, yet this has perhaps been the most rewarding learning for me. One of most important concepts I have learned is that it truly is valuable to care for oneself and that caring for oneself contributes care to the whole system. The balance and connection with nature I had been advocating for professionally was absent in my personal life and appears to be a deep personal need in my own family. This factor is, perhaps, what all humans need to restore the balance on the planet.

My practicum work was challenging academically, professionally, and personally. I observed patterns in myself that revealed continued opportunities for embracing dialogue, suspension, freedom, interconnectedness, and letting go. Montessori's words about observation, the writings of Krishnamurti, and the work of Varela have been instrumental in revealing these opportunities for growth.

Looking at living systems, I perceive that a system is made up of many component parts and those parts each respond individually to the whole. As a component in two living systems, La Tierra and Madrasat Ardh al Amel, I have experienced the phenomena of the structural shifts that occur when one component (including myself) changes. However, like any living system, these two schools are self-organizing. Radical fluctuations or bifurcation points in living systems may or may not be amplified and may or may not cause reorganization. Schools, which traditionally have very set mechanistic structures, may need ample time and generosity to incorporate the organization of systems, particularly with regards to autopoiesis.

Berry suggested a species level shift towards balance with living systems. This shift may need to happen at this time on the Earth, as exemplified by the global circumstances and the conditions in New Mexico and Algeria as outlined in this paper. Yet, I understand that changes happen in the individual and that individual changes may affect the system as a whole in ways that are unexpected and unknown.

Based on my experiences working with children and my work in the TIES program, I believe that children today have needs and challenges that are vitally important to acknowledge and address, including a disconnection from the natural world, overemphasis on consumption, lack of food security and quality, and education that addresses the needs of each individual child. My hope and endeavor is to support my own children in these areas and to continue to be present for supporting schools and educational approaches that honor living systems for children in my communities, including La Tierra and Madrasat Ardh al Amel. It is my assertion that the developed countries of the West--like the United States--where resources are disproportionately

distributed and opportunities abound, have a particular responsibility to lead the way in addressing these issues.

Presenting an education that honors living systems, to me, includes operating as living systems. Schools that wish to incorporate such ideas may embrace the qualities of those systems-individual autonomy, equality, dialogue, a wide range of opportunities, and an orientation to the broadest context possible-the Universe itself.

Montessori education,based on the evidence presented in this paper, is an approach to education that includes the process, pattern, and structure of living systems. When interpreted using the writings of Maria Montessori herself, I found great inspiration that guided my studies. Finally, schools that desire to organize as living systems may look to the new sciences for direction in building relationships with staff, parents, and community.

Allowing freedom and autonomy for each voice in the system may be a great challenge, but one well worth the endeavor. Schools may look not only toward the new sciences and the work of Montessori, but also the living Earth itself as a primary teacher of the nature of living systems. As educators draw closer to restoring the balance between humans and nature, perhaps we may find a shift in the human perspective on the value of individual life. If disposable individuals, species, and ecosystems no longer exist, then each may have a place and purpose in this--our great work--of sharing and creating together as an interconnected living Earth community.

Appendix A: Learning Proposal

A. Field of Emphasis: Montessori Education and Learning in Living Systems

Write two to three paragraphs about this area of interest, your background as related to the topic and what compels you to explore this field.

I am interested in developing a deeper understanding of how outdoor environments can be used across the curriculum in outdoor learning environments, including the school garden, naturalistic spaces, and spaces designed for creating learning contexts. I am especially interested in ways that learning in the natural environment can be used to create a love of and interest in the seemingly endless diversity of living things, and how that interest can be used to cultivate a love for the Earth and a shift in attitudes towards living systems for students educated in this way. I hope to accomplish this through careful lesson plans that offer Montessori teachers immediate access to simple and beautiful lessons in the outdoors.

I have been working in outdoor environments with children for some years, and I have a background in Landscape Architecture. I have been heavily influenced by a professor in the Landscape Architecture department at Colorado State University, who has been designing children's gardens for more than twenty years. His love of creating outdoor spaces is partially responsible for my decision to move away from design and towards children. It's exciting for me to bring these disciplines back together again for a deeper look.

B. Questions:

What curriculum already exist for school gardens and outdoor learning environments?
How can these curricula be modified to reflect Montessori practice?
What resources are available for developing a school garden?
What resources are available for developing a school kitchen?
How can Language, Math, and other content areas be incorporated into learning in outdoor environments?

C. Emphasis Area Resources:

Web resources to investigate:
www.farmtotablenm.org
www.ecoliteracy.org
http://www.chefann.com/html/whats_new.html
http://naturalplaygrounds.com/

Books/Publications to investigate:

Smart by Nature: Schooling for Sustainability, Michael K. Stone
Schoolyard-Enhanced Learning: Using the Outdoors as an Instructional Tool, K-8

*Ten Years of Education at the Edible Schoolyard

Principles of an Edible Education (ESY)

The Garden Companion (ESY)
The Kitchen Companion (ESY)
*One Straw Revolution (Masanobu Fukuoka)
Greening a K-12 Curriculum(CE)

D. Practicum or Experiential Learning

I would like to use my practicum time for preparation of lessons for use in outdoor environments, connecting the Montessori K-8 curriculum to the outdoor environment at Madrasat Ardh al Amel (Hopeland Academy) in Algiers, Algeria and La Tierra Montessori School in Espanola, New Mexico, USA

Specific steps to take in the practicum:
Taking ideas from bibliography and creating lesson plans for use in Montessori K-8 classrooms.
Maintain existing garden beds with students/including weeding, pruning, feeding, planting, watering, harvesting, cooking, and eating.
Developing specific ideas for essential elements to include in outdoor Montessori learning environments.

Appendix B: Lesson Plans for Learning in Living Systems

Contents

Walk through 13.7 Billion Years

MATERIALS: Night Sky
A Large field, about 130 feet in length with two recognizable landmarks-trees or rocks
Candles or flashlights

PREPARATION: Initial presentation of First Great Lesson.

DIRECT AIMS: To develop understanding of the scale of time related to the development of the Universe.

INDIRECT AIMS: To develop an appreciation of one's own identity in his or her place in time and space.

AGE: 6 years and up.

PRESENTATION:

1. Begin in the field with a group of students under the night sky.
2. Explain to the students that you will walk across the field to represent the time that has passed since the birth of the universe, approximately 13.6 billion years, and that each foot represents one hundred million years, that ten feet is one billion years.
3. Stand at one landmark and gaze across at the other side, 130 feet away.
4. Light a candle or flashlight and place it at the beginning point or "time zero", the time of the great flaring forth.
5. Walk ahead together three feet, explaining that you have covered three hundred million years, when atoms of hydrogen and helium first formed-the first atomic "life". Place a candle at this spot.
6. Continue walking another seven feet, lighting a candle at one billion years. Explain that at this time, many of the galaxies were forming, including the Milky Way. Place a candle at this point.
7. Walk forward approximately seventy feet, to the time when our own solar system was forming, 4.6 billion years ago. Place a candle at this point.
8. Walk ahead ten feet or 1 billion year, to the time when bacteria was first forming in the oceans of Earth. Place a candle at this point.
9. Go forward three feet to the time when photosynthesis first took place, 3.6 billion years ago. Place a candle at this point.

10. Walk forward sixteen feet to the time when the first nucleated cells emerged, 2 billion years ago. Place a candle at this point.
11. Go forward ten feet to the time when single celled organisms gained the ability to combine genetic material and create diverse life forms, 1 billion years ago. Place a candle at this point.
12. Continue walking and placing candles for the following events:
13. 4 feet, the first multicellular organisms appear, 600 million years ago
14. One foot, the first organisms with backbones appear in the oceans, 500 million years ago.
15. One foot, life forms leave the water and onto land, 400 million years ago.
16. One foot, the first forests appear, 300 million years ago.
17. One foot, Dinosaurs diversify, mammals appear, and the first birds develop, 200 million years ago.
18. One foot, flowers are evolving and insects feed on nectar and pollen, 100 million years ago.
19. One-half foot, dinosaurs disappear, mammals begin to flourish, 65 million years ago.
20. Three inches, human ancestors leave the forest and stand on two legs, 4 million years ago.
21. Two inches, early humans use hands and minds to make tools, 2 million years ago.
22. One inch, modern humans emerge with language, clothing, shelter, fire, music, art and religion, 100,000 years ago.
23. One twelfth of an inch, humans domesticate animals and cultivate plants, 10,000 years ago.
24. Directly next to previous candle, humans discover they live in an expanding universe, 75 years ago.
25. Directly next to previous candle, humans travel into space and see the planet Earth for the first time, 35 years ago.
26. End of the field, the humans in the field tonight tell the story of the great flaring forth to the present moment.
27. Stand at the present moment in time and ask students to share personal statements about their experience in the moment.
28. Look back across the field at the span of time from the flaring forth and spend some time to reflect.
29. Walk back through time to the great flaring forth, reflecting on all the developments that happened from that moment to the present one.

VOCABULARY:

1. great flaring forth
2. landmark
3. time zero
4. atomic life
5. photosynthesis
6. nucleated cells
7. ancestors
8. domesticate
9. cultivate
10. expanding
11.

POINTS OF INTEREST:

1. The night sky
2. The story being told
3. The candles or lights being placed on timeline
4. The stars
5. The moon, if it is visible
6. The other objects and constellations in the sky
7. Being outside at night

CONTROL OF ERROR:

1. Rocks or other markers can be set out in the field ahead of time to ensure correct placement of candles or flashlights.

VARIATIONS:

1. This lesson could be done in a large pool with floating candles or lights.
2. The size of the field could be modified to be larger or smaller.

EXTENSIONS:

1. The walk through time could happen before or after the first Great Lesson. If it happened after the Timeline of Life, each student could prepare a statement to recite at one stop on the journey through time.
2. Permanent markers could be made to illustrate the development of the Universe and to be used on an individual basis for reflection.

Orientation to the Milky Way

adapted from *Hidden Heart of the Universe*, by Brian Swimme

MATERIALS: A clear Night Sky

PREPARATION: Initial presentation of First Great Lesson.

DIRECT AIMS: To develop understanding of the location of our Solar System in the Milky Way Galaxy.

INDIRECT AIMS:

1. To develop an understanding of the structure of the Universe.
2. To strengthen children's connection to the natural world.
3. To foster understanding of post-Newtonian thinking about the Universe.
4. To develop an appreciation of one's own identity in his or her place in time and space.

AGE: 6 years and up.

PRESENTATION:

1. Go outside on a clear night with a good view of the stars.
2. Invite the children to locate the Milky Way Galaxy in the night sky and wait for someone to find it. If nobody offers, show them which Galaxy is the correct one.
3. Point out the "cloudy" look of the Galaxy, explaining that it looks that way because there are so many stars, 200 to 400 billion in the Galaxy.
4. Ask the children if they know what Galaxy our planet is in. Wait for someone to offer the correct answer. If nobody does, tell them our Galaxy is the Milky Way.
5. Wait to see if there are any comments.
6. If there are no comments, ask the children how it is possible to be located in the Milky Way and still be able to observe the Galaxy from our planet.
7. Wait for comments and new questions to arise, going with the flow of the conversation.
8. If there is not a satisfactory answer given, explain that the Milky Way is a very large Galaxy, and that it looks like a bulging pancake, a manta ray or a fried egg, with a thick spot in the middle.
9. Explain that our star, the Sun, and the solar system that revolves around our Sun are about 2/3 of the way from the center on a thin edge, that is tipped inward towards the center.
10. Invite the children to reflect, ask questions, and look at the Milky Way.

VOCABULARY:

1. Milky Way
2. Galaxy

3. manta ray

POINTS OF INTEREST:

8. The shape, size and appearance of the Milky Way galaxy.
9. The stars
10. The moon, if it is visible
11. The other objects and constellations in the sky
12. Being outside at night

CONTROL OF ERROR:

1. The Milky Way can be found in the night sky. There is no way to not see it.
2. It is best to view the Milky Way on a summer evening in the northern hemisphere and a winter evening in the southern hemisphere.

VARIATIONS:

1. Bring a picture of the Milky way, a pancake, egg, manta ray, or other image that might aid children in finding the Galaxy.

EXTENSIONS:

1. Combine this lesson with one or two others. Try not to give too much information in one sky viewing.

Orientation to the Movement of the Planets

adapted from *Hidden Heart of the Universe*, by Brian Swimme

MATERIALS: A clear place to view the sky at sunset
a model of the Solar System orbits (optional)

PREPARATION: Initial presentation of First Great Lesson, Orientation to the Milky Way, Orientation to Andromeda.

DIRECT AIMS: To develop experiential understanding of the orbits of the Earth and the other planets in our Solar System.

INDIRECT AIMS: To develop an understanding of the structure of the Universe.

AGE: 6 years and up.

PRESENTATION:

1. Go outside on a clear evening about 1/2 hour before sunset.
2. Bring a child.
3. Find Venus low on the horizon.
4. Think of the Solar System in motion-bring a model if you like to illustrate this.
5. Tell the child, "Venus is 65 million miles from the Sun-one third closer than we are. The Earth is 95 million miles from the Sun."
6. Explain that the Sun is 1 million times bigger than the Earth, and it holds the Earth and other planets in orbit through its magnetic power.
7. Suggest the child try to experience the Earth's orbit and the other planets moving around a common center, the Sun.
8. Observe yourself and the child for an "indescribable weightless feeling" as the experience of the Earth orbit comes together.
9. If you like, offer to the child the perspective that many people regard the Earth as fixed, or unmoving in the Universe.
10. Share perspectives on the experience of the movements of planets.

VOCABULARY:

1. orbit
2. Venus
3. million
4. magnetic
5. weightless

POINTS OF INTEREST:

13. The sight of the sun low in the sky
14. The appearance of Venus in the sky
15. The stars as they begin to appear.
16. The moon, if it is visible.
17. Clouds, birds, airplanes and other objects visible in the sky.
18. The feeling of the air, motions of trees and plants, sounds in nature.

CONTROL OF ERROR:

1. Perhaps the only control of error in this lesson is repetition. Since the Earth actually does move in orbit, the only way to experience it otherwise is through an error in perception, which repeated experiences may resolve.

VARIATIONS:

1. Do the exercise in pairs or small groups.

EXTENSIONS:

1. Gaze at Venus through a telescope while doing the exercise.

Orientation to Andromeda and the Local Group

adapted from *Hidden Heart of the Universe*, by Brian Swimme

MATERIALS: Night Sky with a clear view

PREPARATION: Initial presentation of First Great Lesson, Orientation to the Milky Way, Looking Down at the Stars

DIRECT AIMS: To develop awareness of other galaxies that can be seen in the night sky, the proportion of the Milky Way to Andromeda, and the components of the Local Group.

INDIRECT AIMS:

1. To develop an understanding of the structure of the Universe.
2. To develop understanding of the vast numbers of galaxies and stars in the Universe.
3. To strengthen children's connection to the natural world.
4. To foster understanding of post-Newtonian thinking about the Universe.
5. To develop an appreciation of one's own identity in his or her place in time and space.

AGE: 6 years and up.

PRESENTATION:

1. Go outside with children on a clear night with a good view of the night sky.
2. Locate the Milky Way Galaxy.
3. Offer that the Milky Way has between 200 and 400 billion stars in it.
4. Ask if anyone knows where Andromeda Galaxy is.
5. If no one offers, or Andromeda is not found, point it out (use a chart of the constellations if necessary).
6. Explain that the blurry blue light look of Andromeda is because there are so many stars, and that Andromeda has about the same number of stars as our Galaxy.
7. Offer that the light from Andromeda took 25 million light years to reach us, and that 25 million years ago, we were just learning how to make tools on Earth.
8. Explain that Andromeda and the Milky Way pinwheel around each other, and that each have a half a dozen smaller galaxies around them.
9. Around the Milky Way: Magellanic Clouds, Fornax, Draco, and Sculptor.
10. Around Andromeda: M32.
11. Explain that all of these galaxies make up the Local Group
12. Explain that the Local Group is a small satellite of a larger system that revolves around the Virgo Cluster-thousands of galaxies, statistically, each one could contain 10 million intelligent planets.
13. Brian Swimme: "If we can now bring ourselves to imagine this immense supercluster as being a single white dot, then the universe as a whole consists of ten million of these that are

floating, drifting, and twirling as apple blossoms do when in the early spring a gust of wind frees them from their branches and carries them aloft into the blue sky" (p. 62).

VOCABULARY:

1. Andromeda
2. Magellanic Clouds
3. Fornax
4. Draco
5. Sculptor
6. M32
7. Local Group
8. Virgo Cluster
9. Super Cluster

POINTS OF INTEREST:

19. The shape, size, and appearance of Andromeda Galaxy.
20. The shape, size and appearance of the Milky Way galaxy.
21. The stars
22. The moon, if it is visible
23. The other objects and constellations in the sky
24. The ideas being presented
25. Being outside at night

CONTROL OF ERROR:

1. Andromeda may be easy to identify because of its shape and its bright light.
2. Bringing an astronomy chart can provide a control of error.

VARIATIONS:

1. Include pinwheels or other props to illustrate the movement of the Galaxies.

EXTENSIONS:

1. Estimate the total number of stars in the Local Group, Virgo Cluster, or other Galaxies.
2. Make a hanging mobile to illustrate the relationship between Earth and Andromeda.

Looking Down at the Stars

adapted from *Hidden Heart of the Universe*, by Brian Swimme

MATERIALS: Night sky with a clear view of the stars
a land and water globe, or other globe

PREPARATION: Geometric Solids, Layers of the Earth, Land and Water Globe, Orientation to the Milky Way

DIRECT AIMS: To develop understanding of the spherical nature of the Earth.

INDIRECT AIMS:

1. To develop an understanding of the development and structure of the Universe.
2. To develop an understanding of the force of gravity on the Earth.
3. To strengthen children's connection to the natural world.
4. To foster understanding of post-Newtonian thinking about the Universe.
5. To develop an appreciation of one's own identity in his or her place in time and space.

AGE: 6 years and up.

PRESENTATION:

1. Invite the children outside with you on a clear, dark night.
2. Invite the children to "look up at the stars".
3. After some time of looking up at the stars, show the children the globe.
4. Ask if anyone knows what shape the globe is.
5. Wait for answers. If the answer is not given, you can tell that the shape is a sphere.
6. Ask if someone can volunteer to show the others which side of the Earth is "up".
7. Allow the conversation to naturally flow about the concept of up, addressing issues that surface, like "north" and the Earth's axis, if they are mentioned.
8. Explain to the children that since the Earth is a sphere, there is no up and down, there are only places on a curving sphere.
9. Explain that all of the inhabitants of the Earth are essentially "down", being held to the Earth by the magnetic forces at the core.
10. Explain that most humans on the Earth think of the sky as "up" because they have been taught that. (looking up at the sky, the stars, heaven, god).
11. Holding the land and water globe, with a finger on the continent where you are located, point the spot you are holding towards the ground.
12. As the children to imagine the Earth you are holding is the one they are standing on, and ask them to look "down" at the sky.
13. Explain that the Earth is in space, and that space does not have an up or down orientation.

14. Allow time for reflection and discussion.

VOCABULARY:

1. globe
2. sphere
3. axis
4. curving
5. gravity
6. magnet

POINTS OF INTEREST:

26. Seeing the globe and imagining oneself on it in space
27. The feeling of weightlessness, vertigo, or other orientation sensations
28. the night sky, stars, and other features of the landscape.

CONTROL OF ERROR:

1. Repeating this activity more than once should help orient children to the feeling of looking down.
2. The Earth is round. There is no up, there moving ones head away from the trunk, but that would be “looking down” if one were upside down.

VARIATIONS:

1. This lesson can be done during the day using the Sun to orient towards, or in a house, or anywhere. The Earth is always round, no matter what time it is.
2. One may have the desire to lay down on the Earth during this exercise if he or she becomes dizzy or disoriented.

EXTENSIONS:

1. Present the other planets in the solar system orbits and postulate what it would be like to cross orbits with another planet on which there were humans standing.
2. Explore the expanse of the Milky Way, or larger structures of the Universe and their organization and orientation to our planet.

Local Universe Exercise

adapted from *Hidden Heart of the Universe*, by Brian Swimme

MATERIALS: Paper, notebook
parents who are willing to drive on an adventure

PREPARATION: Writing short essays or stories, writing directions

DIRECT AIMS: To develop writing skills.

INDIRECT AIMS: To develop an awareness of the natural features in one's own environment. To develop a connection to and appreciation for the Earth.

AGE: 6 years and up.

PRESENTATION:

1. Invite some students to the Local Universe Exercise.
2. Offer that before there were roads and signs, people found their way by using natural landmarks.
3. Give examples of natural landmarks like rock formations, mesas, big trees, and rivers. Offer that anything that is made by humans does not count as a natural landmark.
4. Ask the students to write directions to their own home using only natural landmarks. (This is an exercise that might need to be done after school in a car).
5. Wait for a time when the students return with their local universe directions and ask them to trade with another student (this will require both parent's permission-the ones who will follow the directions, and the ones whose house will be located).
6. Wait to find out how the directions worked out, and encourage students to refine, expand, or trade more Local Universe Exercises.

VOCABULARY:

1. local
2. universe
3. landmark
4. formations
5. mesas
6. other names associated with landmarks and natural

POINTS OF INTEREST:

29. Seeing what's beyond the man-made objects
30. Trying to find enough landmarks to give good directions.
31. The excitement of looking for a friend's house
32. The excitement of having a friend find your house
33. Trading Local Universe directions with others

CONTROL OF ERROR:

1. Finding a friend's house using the directions.

VARIATIONS:

1. Give directions to a place on or off campus using only natural landmarks
2. Trade Local Universe directions without telling who's house is at the end.

EXTENSIONS:

1. Two or more students could give directions with more than one stop
2. Students could make a Local Universe map that includes all of the features in the directions, and each student's house.

Green Journal

adapted from *Schoolyard Enhanced Learning*, by Herbert Broda

MATERIALS: A green composition book to be used for a Green Journal
pencils, pens, and other writing utensils
space for each student to have a ten by ten foot square in a natural environment that can be visited throughout the year
stakes or popsicle sticks to mark spaces
a permanent black marker

PREPARATION: Writing Sentences, Classification Cards or similar work,
Living and Non-Living Work,
Graphing, Measuring, Drawing, Sensorial and Botany work.
Map-Making, Mind Mapping.

DIRECT AIMS: To develop understanding of the changes in an ecosystem over time.
To develop observation and data recording skills
To develop skills in the context of an integrated curriculum.

INDIRECT AIMS: To develop an appreciation of the cycles of life in a small environment.
To develop a connection with a particular spot.

AGE: 10 years and up.

PRESENTATION:

1. This activity is intended to be a year-long study of a particular environment throughout the seasons. The adult guide can begin by gathering students together in a class circle time and labeling each Green Journal with a student's name, and explaining that each student will find a special place for study and visit it throughout the year.
2. Students can go out into the environment and find their spot, marking it with popsicle sticks or stakes, and measuring a ten by ten foot area. The student's names can be written on each popsicle stick around the perimeter of the area to ensure that each student remembers the location of their spot.
3. Students can visit their spot throughout the year and record in their Green Journal their observations. Below is an outline of some activities that students can do throughout the year.

September Theme: Classifying

•List at least fifteen things found in your special place.
•Make a table to classify them as living, nonliving, or once living.
•Make a bar graph or pictograph to share your results.
•Write your own definition of the following: living, non-living, once living.

October Theme: Mapping and Measurement

•Draw a map of your special place.
•Include a key, compass rose, measurement scale, and draw from a "bird's eye view".

November Theme: Comparing and Contrasting Seasonal Change

•Make detailed observations (words and pictures) about your special place now that autumn has arrived. Has anything changed? Do you notice anything new? Is anything missing?
•Make a Mind Map to help you organize your thoughts.
•Write a paragraph to compare and contrast late summer and autumn as they relate to your special place.
•Illustrate your paragraph.

December/January Theme: Recording Data and Making Predictions

•Make observations, measurements, and draw pictures about the weather.
•At the end of January, write a summary of December and January's weather.
•What do plants and animals in your special place do to survive in winter? (This may require some research). Predict what will happen to the living things in your special place if you have an especially "hard" winter.

February Theme: Needs of Living Things

•Identify the items in your special place that provide plants and animals with what they need in order to live. You may do this in a table, drawing, or paragraph.
•Make a mini poster for your journal that advertises your special place as a great place for animals and plants to live. Be sure to include the basic needs of living things.

March Theme: Water Cycle and Hypothesis

•Draw and label how the water cycle might occur in your place.
•Make a hypothesis as to what would happen to your special place following a heavy rainstorm. If a heavy rainstorm occurs, make observations to see if your hypothesis was correct.
•Make a hypothesis as to what would happen to your special place in a drought.

April Theme: Signs of Spring and Your Senses

•Use your senses to observe and describe Spring's arrival.
•At the beginning of the month, predict what changes will take place in your place during the month of April. Record your predictions in the journal. At the end of the month, make observations to see if your predictions were true.

May Theme: Reflection and Evaluation

•Take someone with you to your special place. Read your Green Journal to him or her. Show your pictures, graphs, and tables.

•Reflect on all that you have done this year with your Green Journal. Was it a good activity? How might it be improved?

•Write a letter to the teacher that includes the following:

- •What did you think about keeping a Green Journal?
- •What did you like most?
- •What did you like least?
- •Discuss three things you learned by keeping your journal?
- •Do you have any suggestions for next year?
- •How might you have improved your journal?

VOCABULARY:

1. any of the words associated with items found in the natural environment, (i.e., specific plants, insects, or animals, kinds of rocks, etc.).
2. predictions
3. hypothesis

POINTS OF INTEREST:

34. Watching the changes take place over time in a small space.
35. Having a special place that is for one person to study.
36. Keeping the Green Journal and filling the pages with drawings, data, observations, and reflections.
37. Sharing the Green Journal with a classmate.

CONTROL OF ERROR:

1. Popsicle sticks with each student's name written on them can provide a control for the spots.
2. Visually looking at what is in the environment should provide clarity about what is there and what is not, what is happening and what is not.

VARIATIONS:

1. Students can take pictures of their spot every month and put them in their Green Journal.
2. Students can keep a Green Journal of a spot at their own home.

EXTENSIONS:

1. Green Journal elements can be created as displays in the school.
2. Green Journal elements, data, and findings can be made into items for an interpretive signs on a trail.

3. Findings about any element of the special place can be extended to further study in the classroom-especially botany, life cycles, water and carbon cycles, erosion, classification of animals, and research on specific plants and animals.

Fifty Questions in Nature

adapted from *Developing Ecological Consciousness*, by David Uhl

MATERIALS: Clipboard and paper or composition book
pencil or pen
colored pencils, markers, crayons, or other drawing medium if desired
a nice spot in a field, patch of forest, schoolyard, backyard, or other natural place.

PREPARATION: writing sentences, punctuation game.

DIRECT AIMS: To develop writing skills and critical thinking skills.

INDIRECT AIMS: To develop observation skills

AGE: 5 years and up.

PRESENTATION:

1. Invite some students into an outdoor environment and offer to show them the lesson.
2. Offer that sitting quietly and observing life around can lead to many questions about things found in nature. For example,observing smells, quality of the air, sounds, insects, and plants can cause questions like "What bird is that flitting around the bushes? Does it have a nest nearby? What is that ant carrying? Where is it going? Why do different kinds of trees have different kinds of leaves?" (Use these questions or others, either generated from an adult or the students to generate their own examples.
3. Ask each student to find a special place to sit with their clipboard or composition book.
4. Request that students write only about what they actually see, and the questions that arise from their observations.
5. Suggest that students can stay in their spot until they have written all the questions that they have.
6. Suggest that students include drawings.
7. Suggest to the students that they might want to ask 50 questions, or perhaps 5, 10, or 20 questions as they like.

VOCABULARY:

1. observation
2. words associated with what is observed (i.e., bird, ant, etc.)

POINTS OF INTEREST:

38. sitting in an outdoor environment for a school project
39. observing particular circumstances of what is observed
40. the act of questioning what one is seeing
41. the act of wondering about what a particular organism is doing

CONTROL OF ERROR:

1. Organisms or natural objects that do not occur in a specific bioregion or ecosystem would be unlikely to be observed there.
2. An adult guide may want to consider carefully, if evaluating questions, how to respond to individual observations of students. (I.e., a student might describe observations in unconventional ways that are reflective of their own perceptions. These perceptions can be met with an openness from the adult guide.

VARIATIONS:

1. Students can record their questions in composition books or clipboards as they take a walk through an outdoor environment.
2. Students can limit their observations to one kind of creature, plant, or natural feature, (i.e., just birds, just rocks, things that move in the wind, things that are purple, etc.).
3. Students can wear a blindfold and observe without looking, recording their observations after removing a blindfold.

EXTENSIONS:

1. Students can observe both in outdoor environments and indoor environments, and compare their questions generated in each setting.
2. Students can explore further research on topics they encounter in their observations, such as three-part cards, cyle of life cards, or landforms work. In turn, this may lead into further investigations.

Find Your Rock

adapted from *Schoolyard Enhanced Learning*, by Herbert Broda

MATERIALS: A basket containing a collection of similar rocks, with enough for each student to have one plus a few extra

PREPARATION: Rough and Smooth Boards, Pink Tower, Brown Stair, Knobless Cylinders, Knobbed Cylinders, Sensorial Work involving gradation and discrimination.

DIRECT AIMS: To develop discrimination skills.

INDIRECT AIMS: To develop an appreciation of rocks.
To develop interpersonal negotiation skills.

AGE: 4 years and up.

PRESENTATION:

1. Name the activity and invite a group of students. This may be a good circle-time activity, but can be done in small groups also.
2. Check to make sure there are an appropriate number of rocks for the group of students.
3. Bring the basket to a table or rug and place it in front of the students.
4. Ask each student to take a rock, you may pass them around the circle or find another way to distribute them.
5. Give the following suggestions:
6. "Take a very careful look at your rock.
7. Turn it over, look for different colors.
8. Feel the rough and smooth parts of your stone.
9. Does its shape remind you of something?
10. Turn it over again in your hand to look at it even more closely.
11. Put the stone down in front of you. rub your hands together rapidly; now clap the top of each hand, now clap your hands together loudly and vigorously. (or use a sensitizer, if your classroom uses them).
12. Pick up your rock again, and pass it gently over the palm of your hand, now over the top of your hand, now across your cheek."
13. Ask each student to put their rock back in the basket.

VOCABULARY:

1. rock
2. stone
3. rough and smooth
4. shape and the names of shapes

POINTS OF INTEREST:

42. The individual characteristics of each.
43. The interest of comparing and contrasting rocks.
44. The challenge of trying to remember tiny details.
45. The excitement of finding one's own rock again.

*Note: Presenting this lesson could be valuable for children in the sensitive period for attention to small details.

CONTROL OF ERROR:

1. The number of rocks in the basket-if there are exactly as many as there are students, there will be none left. If there are four extra, there should be four left.
2. The students may negotiate about specific details to discern which rocks belongs to whom.

VARIATIONS:

1. The size, number, and differences between stones can be varied to create a more or less challenging activity.
2. Students can use corn kernels, seeds, or other items that may be challenging to distinguish.

EXTENSIONS:

1. Use differences in individual rocks to frame a discussion about the differences between individuals.
2. This exercise could be extended into research or dialogue about geology, types of rocks, erosion, or cycles of nutrients.

Resource Auction

adapted from *Schoolyard Enhanced Learning*, by Herbert Broda

MATERIALS: Printed or laminated cards with the following items listed:

wide screen plasma TV for every home
minivan for every family
twenty-screen movie theater
good library
clear lake and streams
forest of big, old trees
hiking and biking paths
large golf course
many beautiful shade trees
large community pool
large park
giant fast-food court
playing fields for sports
nature center
large shopping mall
new housing development

Lined sheets of paper for bidding
writing utensils-one for each of the bidding sheets
3-5 Groups of $100,000 play money
A clipboard or composition book for each group with writing utensil

PREPARATION: Needs of Humans.

DIRECT AIMS: To develop understanding of the difference between wants and needs.

INDIRECT AIMS: To develop an appreciation of the place of food in one's life

AGE: 10 years and up.

PRESENTATION:

1. Invite students in groups of 3-5 to participate in a resource auction. There should be 3-5 groups.
2. Offer to students that they represent a town council that has just received a grant of $100,000 to improve their community.

3. Suggest that the students' job is to decide what things are priorities for their community.
4. Ask each group to look at the items being offered and decide in advance which things they want to purchase, and explain that all of the money needs to be spent by the end of the auction.
5. Each group should decide in advance what the top bid on their items of choice will be. A discussion about bidding and the process of auctions can be included.
6. Discussion in groups about priorities and bid amounts are an important part of this process and should not be rushed.
7. When groups have come to decisions about these things, ask them to elect a spokesperson, a treasurer, and someone to record purchases.
8. Once those representatives have been chosen, the auction can start.
9. Groups can write their starting bids on auction item sheet, keeping in mind that all money needs to be spent by the end.
10. Bids can be made in 500 dollar increments, and may only exceed the maximum if the whole group agrees.
11. Allow some time for bids to be made on behalf of each community, ten minutes or fifteen minutes, at which time the highest bidder in each auction item will will that item and the treasurer can pay for the items.
12. At this point, the groups should come together again and rethink some of their choices, with the goal of making priorities and of spending all their money.
13. When groups have had enough time to discuss and prepare, the auction can open again for another ten minutes or so, and then close, with items again going to the highest bidder.
14. When the auction closes, the whole group can have a discussion about the process, which includes each group describing what they purchased and the reasoning behind their purchases.
15. The discussion, hopefully, can be oriented towards needs and wants, priorities for high quality of life.
16.

VOCABULARY:

1. minivan
2. widescreen plasma t.v.
3. library
4. fast food court
5. community
6. playing fields
7. paths
8. nature center
9. shopping mall
10. housing development
11. resource
12. auction

POINTS OF INTEREST:

1. Talking about an auction and having a mock auction
2. Using play money

3. Thinking about the best use of resources, discussion
4. The bidding process
5. Seeing what other groups decide
6. Thinking about shifting priorities

CONTROL OF ERROR:

1. The play money must all be spent
2. The auction sheets are a control of which group is purchasing items.

VARIATIONS:

1. Ask groups to pick only one item.
2. Have a silent auction with number cards that each group bids on.

EXTENSIONS:

1. Invite students to participate in grant writing for the school or other real applications of the resource auction.

Measuring an Acre

adapted from H. Broda, Schoolyard Enhanced Learning

MATERIALS: An outdoor environment that is more than one acre.
A long measuring tape.
forty wooden stakes
a rubber mallet for pounding in stakes
a long string or rope

PREPARATION: Measuring activities.

DIRECT AIMS: To orient students to the size of an acre.

INDIRECT AIMS:
1. To develop an appreciation for details of objects found in nature.
2. To strengthen children's connection to the natural world.
3. To orient students to the units of measurement in agriculture.

AGE: 9 years and up.

PRESENTATION:
1. Name the lesson invite the class to measure an acre.
2. Explain than an acre is 43,560 square feet and that you are going to mark an acre on the ground.
3. To figure the sides of the acre, offer that the total area must be divided by two numbers that equal the sum 43,560, and ask students to divide by 220. (This is one side). The solution should be 198. If students come up with different whole numbers, these could also be used.
4. Ask a pair of students to mark out 220 feet with the long measuring stick, putting in stakes every 20 feet.
5. The students can then mark out 198 feet at a right angle to the first line, marking with stakes as they go. The last two lines can be measured in the same manner, and should produce a rectangle.
6. A pair of students can tie the string to one stake and connect it to each stake around the rectangle, wrapping the string around each stake as they go.
7. Observe the rectangle that was made, and offer that this is an acre.

VOCABULARY:
1. acre, feet, yards.
2. area.

3. words related to agriculture.

POINTS OF INTEREST:

46. The environment of the natural world.
47. The fine details of objects in the natural environment.
48. Measuring out the area with a long tape.
49. Marking the area with stakes.
50. Pounding the stakes into the ground.

CONTROL OF ERROR:

1. site maps of the property
2. measuring tape
3. stakes at twenty foot intervals

VARIATIONS:

1. Ask the students to calculate different ways of staking out an acre, and graph the geometric shapes each acre can be made in.
2. Ask students stake out different units used for agriculture (i.e., hectare).

EXTENSIONS:

2. Map out several acres and mark for planting different crops.
3. Make a one-foot grid inside the acre and count the square feet.
4. Calculate number of rows that can fit into an acre.
5. Calculate the number of plants (i.e., corn plants) that will be planted in one acre and express as arrays and multiplication problems.

Living/Non-Living in the Outdoors

adapted from *Schoolyard Enhanced Learning*, H. Broda

MATERIALS: An outdoor environment
a collection of found objects
label cards for Living/Non-Living

PREPARATION: Living/Non-Living Classified Cards.

DIRECT AIMS: To make the distinctions between living and non-living items in the environment.

INDIRECT AIMS: To develop an appreciation for details of objects found in nature.

AGE: 4 years and up.

PRESENTATION:

1. Prepare the outside environment by placing the non living objects in various places that the children will find.
2. Invite some children to come outside with you and find living and non-living items
3. Place label cards for living and non-living items in an area where all the students can access them.
4. Ask the children to find items they think are living and not living and to place them with the cards.
5. When they feel finished finding items, discuss the items found and whether or not they might be living or non-living

VOCABULARY:

1. non-living
2. living

POINTS OF INTEREST:

51. The environment of the natural world
52. The surprise of a found object in the natural world
53. The thought of a non-living item being alive and vice versa

CONTROL OF ERROR:

1. It may be challenging to define some of the objects as either living or non-living
2. Control cards can be used to ensure all of the non-living objects are returned.

VARIATIONS:

1. Ask children to stand by or point to living and nonliving items.

EXTENSIONS:

1. Look for living and non living items in the classroom.
2. Look at items which are no longer living and discuss, like dead leaves, insects, etc.

Geometric Solid Matching

MATERIALS: An outdoor environment
Geometric Solids

PREPARATION: Matching and Grading materials, Geometric Solids.

DIRECT AIMS: To strengthen discrimination skills using geometric solids.

INDIRECT AIMS:
1. To develop an appreciation for details of objects found in nature.
2. To strengthen children's connection to the natural world.

AGE: 4 years and up.

PRESENTATION:
1. Name the lesson invite 3-4 students to match geometric solids to the outdoor environment.
2. Take the geometric solids and place them in a basket.
3. Ask each child to choose a solid and hold it in their hands.
4. Invite the children to go out into the environment to look for natural items that match the geometric solid they have. Encourage them to find objects that are not exactly the same as the solids, but similar.
5. Students can bring the solids back to a table or central location with their objects and place them there for display and discussion.
6. Continue working with matching solids to natural objects until the children are finished.

VOCABULARY:
1. geometric solids
2. the names of the individual solids
3. the names of objecst found outdoors

POINTS OF INTEREST:
54. The environment of the natural world
55. The fine details of objects in the natural environment
56. Looking for geometric objects
57. Looking for particular attributes of geometric solids.
58. Comparing the solids to found objects
59. Seeing the objects that other students gather
60. Looking at the items on display
61. Seeing variations in shape, size, and other attributes in natural objects.

CONTROL OF ERROR:

1. The geometric solids
2. Peer review.
3. The physical attributes of the items found.

VARIATIONS:

1. Ask students to find objects that are less than one inch to match to geometric solids.
2. Ask students to find objects that fit into the base cards of the geometric solids.

EXTENSIONS:

3. Ask students to find objects that look like a composite of two or more geometric solids.
4. Ask students to find objects that look like geometric solids that have been cut into pieces.

Human Graphs

adapted from Schoolyard Enhanced Learning, by Herbert Broda

MATERIALS: Printed, laminated cards with the months of the year on them
Printed, laminated cards with seasons of the year on them
an outdoor space large enough to hold students lying down, and preferably comfortable, like a grassy area or soft surface.
a camera.
chalk or string.

PREPARATION: none.

DIRECT AIMS: To develop graphing skills.

INDIRECT AIMS: To develop an appreciation of outdoor environments.

AGE: 5 years and up.

PRESENTATION:

1. Invite a class to create a Human Graph in the outdoor environment.
2. Go out into the environment and explain that the class is going to make a bar graph to show what months of the year students were born in.
3. Ask a student or pair of students to arrange the month cards in order in a straight line at the edge of the space that will be used.
4. Inquire if any students were born in January, and ask those who affirm to raise their hands.
5. Invite one student at a time to lay down on the ground, with the first student's feet directly above the card "January". Once this student has gotten down, the next one can lie with their feet directly above the first student's head. (You may want to remind students to be careful about not kicking or disturbing other students).
6. Continue on in this way until all students are in the bar graph, and take a picture. You may want to invite one month at a time to look at the graph, if the students are able to stay in place.
7. Invite all the students to stand and make a pie chart.
8. Ask students to form a circle in the order of the months they were born, and to discern what seasons their birthdays fall in.
9. One or two students can place the season cards in the center of the circle and chalk lines can be made to draw the inner circle around the feet, and divide the circle into the seasons represented by students. (This will need to take place on a hard surface or be done with string, if chalk will not work).
10. Take a picture.

11. Invite the students to replicate their graphs in their composition books or paper.

VOCABULARY:

1. bar graph
2. pie chart

POINTS OF INTEREST:

1. Being in the outdoor environment.
2. The act of lying on the ground to make a graph.
3. Finding others with similar birthdays.
4. Seeing the numbers of students with birthdays in particular months.
5. Working on the pie chart.
6. Standing in a circle.
7. Seeing the chalk lines created for the seasons.

CONTROL OF ERROR:

1. The students' knowledge about their birthdays.
2. School records.

VARIATIONS:

1. Human graphs can be made using favorite colors, male and female, hair color, or other characteristics.

EXTENSIONS:

1. Students can generate data using human graphs on a regular basis and make comparative charts and graphs over time. For example, human bar graphs could be made each month to record how many students were recycling at home or who were participating in after school activities.

Breathing with Plants

adapted from *Developing Ecological Consciousness*, by Christopher Uhl

MATERIALS: Individual plants or tree branches for each student to breathe with

PREPARATION: none.

DIRECT AIMS: To develop understanding of the exchange of oxygen and carbon dioxide between plants and animals.

INDIRECT AIMS:
1. To develop an understanding of the processes of atmospheric gases.
2. To develop an understanding of the connectedness of human life to plant life.
3. To develop an appreciation for plant life.

AGE: 6 years and up.

PRESENTATION:
1. Invite some children to come breathe with plants.
2. Go outside to a natural area and locate a tree branch or plant and stand beside it.
3. Invite the children to find a tree branch or plant and stand beside it.
4. Explain that humans breathe oxygen and plants breathe carbon dioxide.
5. Explain that humans exhale carbon dioxide and plants exhale oxygen.
6. Put your mouth and nose close to a leaf on the tree or plant.
7. Take a deep breath.
8. Explain that you are breathing in oxygen that the plant is exhaling.
9. Breathe out.
10. Explain that the plant is breathing in carbon dioxide that you are exhaling.
11. Take a moment to breathe in and out with the plant.
12. Invite the children to do the same.
13. Reflect on being with the plants.

VOCABULARY:
1. oxygen
2. carbon dioxide
3. exhale
4. inhale

POINTS OF INTEREST:

62. The individual tree or plant and its characteristics
63. The individual leaf and its details
64. The idea and experience of breathing with a plant
65. Being outside in nature.

CONTROL OF ERROR:

1. The exchange of carbon dioxide and oxygen between plants and animals is real. If it did not occur, we would not be able to stay alive.

VARIATIONS:

1. Try exchanging love or good feelings with the leaf or plant.

EXTENSIONS:

1. Try breathing with a plant or leaf that has been picked and explain that it will stop producing carbon dioxide.

See What I Found Poems

adapted from *Schoolyard Enhanced Learning,* by Herbert Broda

MATERIALS: An outdoor environment
pencil or pen
paper
white board and marker

PREPARATION: writing words on lines, grammar work with nouns, adjectives.

DIRECT AIMS: To develop creative writing skills.

INDIRECT AIMS: To develop an appreciation of outdoor environments, to develop an appreciation for poetry.

AGE: 6 years and up.

PRESENTATION:

1. Invite a small group of students to write "See What I Found Poems".
2. Using a white board, show the students that the poems have five lines. Write the following words on the white board:

First Line:	See what I found?
Second Line:	(name of object)
Third Line:	(adjectives and descriptive phrase)
Fourth Line:	(tell where you found it)
Fifth Line:	(make a comment or question about it)

3. Ask the students to copy the guidelines for the poems in their notebooks.
4. Write your own poem with an item that you found in the outdoor environment or this example:

See what I found?
A butterfly.
Flitting and flowing in the sunlight.
It's resting on a flower.
I wonder how long it will stay?

(Encourage the children not to bring living things into the classroom if they are the subject of the poem)

5. Invite the students to go into the outdoor environment and find an object or subject to write their poem about.
6. Share poems with the group, display them, or put them in a special work portfolio.

VOCABULARY:

1. found
2. object, subject
3. the name of the subject found
4. adjectives to describe the subject

POINTS OF INTEREST:

1. The subject of the poem.
2. The surroundings of the subject
3. Details about the subject
4. Being in an outdoor environment

CONTROL OF ERROR:

1. The physical item that is the subject of the poem
2. The guidelines for writing poems

VARIATIONS:

1. Add lines to the poems or make drawings to accompany them
2. Have students take pictures of their subjects to display with the poems.
3. Ask students to find items that are smaller than a thumbnail for their poems.
4. Ask students to write a poem about something they see while sitting in the environment that is no further than three feet away.

EXTENSIONS:

1. Students can investigate the habitat or surroundings of their subject, and write poems about what they see.
2. Students can do research on the subjects of their poems in the classroom.

Water Evaporation

adapted from *Schoolyard Enhanced Learning*, by Herbert Broda

MATERIALS: A one-cup measuring pitcher
string
a piece of chalk
scissors
a clock or time keeper
composition book or paper and writing utensil
a yardstick or measuring tape

PREPARATION: Graphing.

DIRECT AIMS: To develop an understanding of the process of evaporation.
To develop geometry skills in perimeter measurement.
To develop the skill of graphing.

INDIRECT AIMS: To develop a relationship with learning in outdoor environments.

AGE: 8 years and up.

PRESENTATION:

1. Invite a student or group of students to the lesson.
2. Explain that this lesson is an experience geared toward learning about how water evaporates, and an inquiry into the rate of evaporation.
3. Ask a student to fill the measuring pitcher to the one cup line.
4. Invite the student(s) into the outdoor environment and ask them to find a clear, level place on a sidewalk.
5. Invite the student to spill the water entirely onto a spot on the sidewalk, and then draw a line with the chalk around the water.
6. The students can check the time on a clock or watch and record this time in a composition book or piece of paper.
7. Ask the student(s) to wait ten minutes and return, drawing a new line around the area where the water is still visible. This process should continue until all of the water is gone, at ten minute intervals.
8. When the water is fully evaporated, ask the student(s) to pull a string around the largest chalk perimeter and cut it to match exactly to the chalk line.
9. The measurement and cutting of string can continue until all chalk lines have been replicated.

10. Once all the string is cut, the student(s) can measure each piece of string and record the length with the corresponding time.
11. Students can create a line graph showing the elapsed time on one axis and the length of string on the other.

VOCABULARY:
1. evaporation
2. perimeter
3. interval

POINTS OF INTEREST:
1. Obtaining the water from a water source.
2. Seeing the water spill on the sidewalk.
3. Watching as the water evaporates.
4. Recording rings using chalk lines.
5. Measuring and cutting string to match chalk lines.
6. Creating a graph.
7. Being outside.

CONTROL OF ERROR:
1. The chalk lines are a control of error for the string.
2. The clock is a control for the intervals, and could be replaced with an alarm or stopwatch for accuracy.

VARIATIONS:
1. This lesson can be done in the shade, on a piece of cloth, or on a rock.

EXTENSIONS:
1. Students can take the perimeter of the string and calculate area, charting the results
2. Students can estimate the amount of water evaporation in each ring as percentages or liquid quantities.
3. The Water Evaporation lesson can be repeated on sunny and cloudy days, or in different seasons and compared.

Examples of charting setup and a completed line graph are shown below.

Time Intervals	Length of String
10 minutes	
20 minutes	
30 minutes	
40 minutes	
50 minutes	

Example of a line chart generated from Water Evaporation with intervals on the x-axis and centimeters on the y-axis.

Leaf Cabinet Matching

MATERIALS: An outdoor environment
Botany Cabinet of Leaves I or II

PREPARATION: Matching and Grading materials, Geometric Cabinet.

DIRECT AIMS: To strengthen discrimination skills using different kinds of leaves.

INDIRECT AIMS:
1. To develop an appreciation for details of objects found in nature.
2. To strengthen children's connection to the natural world.

AGE: 4 years and up.

PRESENTATION:
1. Name the lesson invite 3-4 students to match leaves to the leaf cabinet.
2. Take all of the trays out of the botany cabinet and place on a large table. Make sure that there is space between each inset and leaf for the matched leaves to sit on the table.
3. You may want to take out each leaf inset and set it to one side of its frame.
4. Begin by asking each child to go into the outdoor environment and find a leaf.
5. When the children return, ask each one to look at the insets and find the inset that is the best match for their leaf.
6. Ask the child to place the leaf next to the inset.
7. Continue matching leaves to the insets until all are identified or the children are satisfied with their work.

VOCABULARY:
1. leaf, leaves
2. botany cabinet
3. the names of trees/plants of leaves collected (oak, cottonwood, etc.)

POINTS OF INTEREST:
66. The environment of the natural world
67. The fine details of objects in the natural environment
68. Looking for leaves
69. Looking for particular attributes of leaves.
70. Finding an inset to match one's leaf to.
71. Seeing the leaves that other students gather

CONTROL OF ERROR:

1. The insets.
2. other leaves.
3. The children.

VARIATIONS:

1. Ask the students to find leaves that fit exactly into each inset.
2. Bring a pile of various collected leaves and ask the students to sort them.
3. Place each tray on a different table and sort leaves by major attributes.

EXTENSIONS:

4. Use nomenclature cards to match with leaves
5. Grade each pile of leaves by size, color or other attributes
6. Make collages with the leaves.
4. Use the leaves and insets for tracing onto paper and compare

Leaf Poem

adapted from *Schoolyard Enhanced Learning*, by Herbert Broda

MATERIALS: An outdoor environment
Thin strips of paper 8 1/2" long and 2" wide
scotch tape
pencils
clipboards

PREPARATION: writing on lined paper.

DIRECT AIMS: To introduce poetry as a creative writing tool.

INDIRECT AIMS:
1.To develop an appreciation for details of objects found in nature.
2.To work on broadening use of adjectives.
3.To develop order, concentration, coordination, and independence.

AGE: 6 years and up.

PRESENTATION:
1. Name the lesson and invite the child.
2. Show the child the strips of paper and take one.
3. Place the strip of paper on a clipboard.
4. Place a clipboard on a table or workspace that you can return to.
5. Next, tell the child that you are going to search for a leaf, and invite her to watch.
6. Go out into the environment and look around carefully until you have found a leaf that you are interested in.
7. Return to the table with the leaf, and attach the leaf to the paper with a loop of scotch tape.
8. Sit at the table and ask the child to sit with you.
9. Explain that you are going to write the first word that you think of when looking at the leaf.
10. Write a word, centered on the paper.
11. Explain that you are going to write another word on the next line
12. Continue writing words until you are satisfied.
13. Show your work to the child, and invite her to make a leaf poem.

VOCABULARY:
1. Poem
2. Name of leaf type
3. adjectives associated with leaf

POINTS OF INTEREST:

72. The environment of the natural world
73. The fine details of the veins of the leaves, the edges, and other features
74. The visual contrast between the leaf and the paper.

CONTROL OF ERROR:

1. The thin paper helps to ensure that only one word is placed on a line.
2. The tape holds the leaf onto the paper.

VARIATIONS:

1. Write a poem about any object found in the outdoor environment.
2. Write a poem about two objects taped to the paper.
3. Ask several children to each write one line of the leaf poem

EXTENSIONS:

1. Combine two or more leaf poems into a story.
2. Write poems on the other pars of the plant and make a narrative poem.

Nano Hike Guide

adapted from Schoolyard Enhanced Learning, H. Broda

MATERIALS: An outdoor environment
a meter stick or yard stick
A basket containing:
Small pieces of card stock
Popsicle sticks
pre-cut pieces of string, approximately 3 1/2 meters/yards long
glue
colored pencils or markers

PREPARATION: writing on lined paper.

DIRECT AIMS: To practice writing nouns and adjectives associated with features found in the natural environment.

INDIRECT AIMS: To develop an appreciation for details of objects found in nature. To work on broadening use of adjectives. Measuring a meter or yard with a stick. Creating a square shape. To develop order, concentration, coordination, and independence.

AGE: 6 years and up.

PRESENTATION:

1. Name the lesson invite the child.
2. Tell the child that you will make a hike for a bug to take through a special spot.
3. Show the child the basket of materials and take it.
4. Take the basket to the outdoor environment and tell the child that you are going to find a special spot for a nano hike.
5. Scan the environment and then pick a spot.
6. Lay the meter stick on one side of the spot and push popsicle sticks into the ground at both ends.
7. Continue marking the spot until you have marked out a square meter.
8. Take a piece of string and tie one end to a popsicle stick, then wrap the string around the next two sticks to create a “fence” that wraps around three sides of the spot.
9. Sitting in front of the open end of the square, find an entrance to the nano path.
10. Take one of the pieces of cards stock and write the word “Enter” on the paper, glue it to a stick, and push it in to the ground.

11. Look for the first stop on the path-something that might be an interesting feature for a bug-a rock, a small plant, or other item. Write a sign for this feature (i.e., smooth black rock) and push it into the ground. Emphasize the aim of pointing out real features, not imaginary ones (i.e., an ant-hill should be labeled as such, not a "castle").
12. Continue writing signs for the nano hike until you have completed a path for the bug to walk through.
13. Finish by making a sign with your name and the name of the nano environment (i.e., Prairie's Beetle Forest Hike".
14. Put the basket away on the shelf and invite the child to create a nano hike.

VOCABULARY:

1. hike
2. path
3. adjectives associated with nano hike

POINTS OF INTEREST:

75. The environment of the natural world
76. The fine details of objects in the natural environment
77. Pushing the popsicle sticks into the ground
78. Making little signs
79. Imagining a bug going on a nano hike
80. Using colored pencils or markers to decorate signs

CONTROL OF ERROR:

1. The small paper helps to ensure that only a few words can be written.
2. The edges of the nano hike square place a limit on the work.
3. The items in the meter square.

VARIATIONS:

1. Children can create a nano hike through a garden be to illustrate how humans should move through the beds.

EXTENSIONS:

1. Children can create videos of their nano hikes and play them for classmates
2. Children can take classmates on a nano-hike tour

Random Sampling

adapted from Schoolyard Enhanced Learning, by Herbert Broda

MATERIALS: Rubber bands for each student with a piece of bright yarn tied to each band.
A hula hoop or other boundary for each student
Clipboards and paper or composition books for each student
Writing utensils.

PREPARATION: Recording data.

DIRECT AIMS: To develop writing skills.

INDIRECT AIMS: To develop an appreciation of the place of food in one's life

AGE: 6 years and up.

PRESENTATION:

1. Invite a group of students to do Random Sampling in the outdoor environment.
2. Gather all of the supplies and go out into the environment.
3. Each student should have a rubber band with yard tied to it. Once these have been distributed, show the students how they can pull back on the rubber band and shoot them into the environment.
4. After the rubber band has landed, walk over to where it is and place a hula hoop around the rubber band. This is the area for the random sample.
5. Look into the hula hoop and see what is there-how many different kinds of plants, how many different kinds of rocks, ant hills, etc.
6. Write the names of each natural item found inside the hula hoop in the composition book or on the paper.
7. Once the names are written down, count how many of each item there is inside the hoop. For example, there may be six clumps of grass, seven rocks, three anthills. Record the numbers for each item.
8. When all of the random samples have been recorded, the students can make bar graphs out of the results.

VOCABULARY:

1. random sampling
2. names for items that are found in the samplings
3. hula hoop

POINTS OF INTEREST:

1. Shooting the rubber bands into the environment
2. Watching the yarn fly behind the rubber band
3. Using hula hoops to locate an area for study
4. Seeing what is in the hula hoop
5. Comparing individual results to the group
6. Making a bar graph

CONTROL OF ERROR:

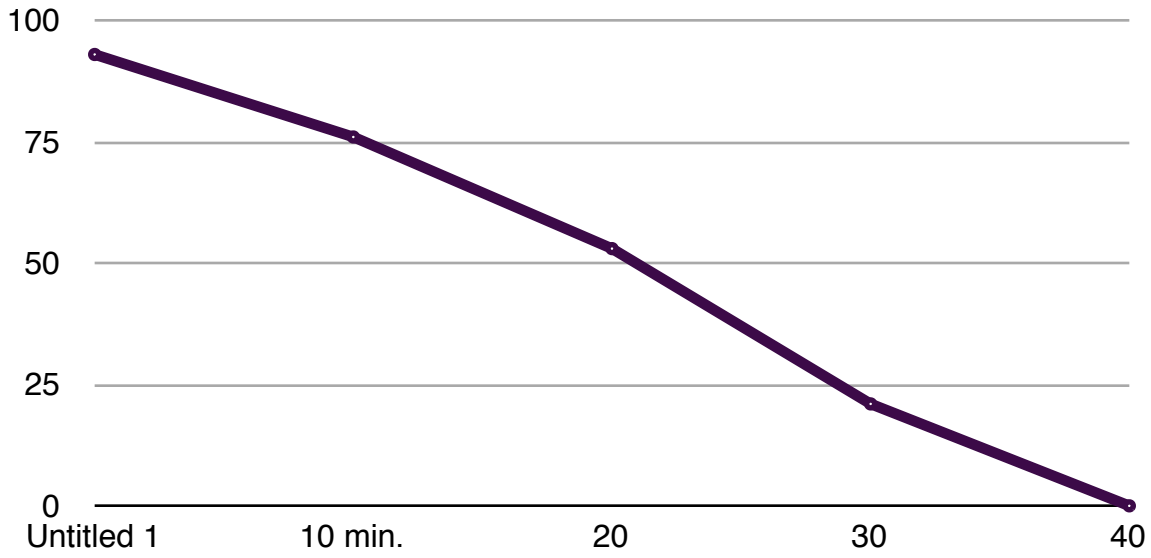
1. Looking into the hula hoop or having another person look.
2. Looking at individual results to check the bar graph results.

VARIATIONS:

1. Use rubber balls or something else to randomly find a place to study in the environment
2. Do a random sample on one item-like number of rocks inside one hula hoop.

EXTENSIONS:

1. Mark areas that have been located for random sampling and check them after one year, and two years. Graph the differences.



Food Survey

adapted from the *Kitchen Companion, Edible Schoolyard*

MATERIALS: Food Survey Sheets or composition books for recording information

PREPARATION: Writing sentences or phrases.

DIRECT AIMS: To develop writing skills.
To think about the role that food has in one's life.

INDIRECT AIMS: To gain understanding of different people's food preferences and eating habits.

AGE: 6 years and up.

PRESENTATION:
1. Invite a group of students, or the whole class to fill out a Food Survey.
2. Suggest that students can consider what kinds of foods they eat and write about their eating habits.
3. Distribute Food Survey Sheets or ask students to copywrite questions into composition books.
4. Ask each student to fill out their Food Survey.
5. Encourage discussion about Food Survey results.

VOCABULARY:
1. specific types of foods that students think of
2. healthiest/unhealthiest

POINTS OF INTEREST:
1. Recalling something pleasant in the past.
2. Remembering the tastes, sights, and sounds of the memory.
3. Thinking about how the food was connected to the memory.

CONTROL OF ERROR:
1. The child's own preferences.

VARIATIONS:
1. Do the Food Survey as a class discussion with a white board or chalk board and record results on the board.

EXTENSIONS:

1. Make a graph of Food Survey results.
2. Plan to cook a popular meal based on Food Survey results.
3. Share results of the Food Survey with the school cafeteria staff.
4. Plan to grow key ingredients in a school garden based on student likes.
5. Plan to try a food that many students are apprehensive about trying.

Food Tasting

adapted from the *Kitchen Companion, Edible Schoolyard*

MATERIALS: ballots for food tasting-one for each student
pencils for each student
several varieties (3-6) of one type of food, i.e., tomatoes, preferably local and organic
cutting board and knife
small plates for all students

PREPARATION: Sensorial work dealing with discrimination. Food related adjective work. Writing sentences.

DIRECT AIMS: To develop prediction skills, descriptive phrases, and create graphs.

INDIRECT AIMS: To develop an appreciation of the place of food in one's life.
To develop food discrimination skills.
To try new foods.

AGE: 6 years and up.

PRESENTATION:

1. Invite the class to participate in Food Tasting that has been prepared by collecting a variety of one type of foods, for instance tomatoes. The foods should preferably be local and organic.
2. Ask one or more students to cut each type of tomato into bite sized pieces and place them on a serving tray with a name card identifying the variety (i.e., cherry tomatoes, heirloom, plum, etc.)
3. Distribute plates, ballots and pencils to each student.
4. Ask students to predict which variety they will like the most as they fill out their ballots with the variety types.
5. Choose which variety to try first, and ask a few students to pass out one piece to each student. Students should wait until everyone has been served, recording their observations about aroma and appearance as they wait.
6. When all students have been served, they can eat at the same time, recording observations about texture and taste.
7. This process can continue until all varieties have been served and observations have been recorded.
8. When this is finished, students can rank their tastings from #1-for the best to the least favorite item.

9. Several students can record tallies regarding the rankings, and bring the results together to create a bar graph of preferences for the class.
10. Discussion about the tasting should be allowed to develop freely.
11. When finished, students can wash their own plates and clean tables.

VOCABULARY:

1. aroma
2. texture
3. appearance
4. taste
5. adjectives associated with food tasting
6. specific names of food varieties

POINTS OF INTEREST:

1. Seeing the different varieties
2. Preparing the food for tasting, putting it onto serving trays and serving
3. Making predictions about favorite foods.
4. Tasting the foods and reacting to them.
5. Having conversations about the experience of tasting.
6. Recording observations on ballots
7. Tallying up ballots and seeing the class preferences.

CONTROL OF ERROR:

1. Ballots with clear areas can be completed in each box.
2. The students' own experiences.

VARIATIONS:

1. Students can try several different foods, instead of the same food.
2. Students can do the Food Tasting exercise with blindfolds.
3. Students can do Food Tasting right in the school garden.

EXTENSIONS:

1. Top choices of the class can be made into recipes.
2. Study of a particular food can continue as research in the classroom.
3. Varieties of foods that can be grown in a school garden can be planted and cultivate.

Writing about a Food Memory

adapted from the *Kitchen Companion, Edible Schoolyard*

MATERIALS: Paper, pencils, or computer

PREPARATION: Writing short stories.

DIRECT AIMS: To develop writing skills.

INDIRECT AIMS: To develop an appreciation of the place of food in one's life

AGE: 6 years and up.

PRESENTATION:

1. Invite a small group of students to write about a food memory.
2. Tell the story of a food memory of your own that you have (i.e., something that your mother or grandmother made that you were fond of, a particular meal). Include details about what the food was, how it was prepared, or what happened in the circumstance that you remember.
3. Invite the students to recall a food memory and write a short story about it-one or two paragraphs, including illustrations of the food or the memory in their story.
4. Ask students to share their food memories with each other, display them in the kitchen, or put them in a special folder.
5. Invite the students to repeat the exercise if they like with another food memory.

VOCABULARY:

1. memory
2. any foods connected with an individual student's memory

POINTS OF INTEREST:

1. Recalling something pleasant in the past.
2. Remembering the tastes, sights, and sounds of the memory.
3. Thinking about how the food was connected to the memory.

CONTROL OF ERROR:

1. The child's own memory

VARIATIONS:

1. Ask students to write about a particular food being studied or grown, like zuchinni, carrots, or apples.

EXTENSIONS:

1. Make food memory stories into a book.
2. Recreate foods in the school kitchen associated with food memories.
3. Talk about what makes food memories special.

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