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Educating for Environmental Literacy in America's Public Schools

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"In the end we will conserve only what we love. We love only what we understand. We will understand only what we are taught."

-Baba Dioum, Senegalese Environmentalist

Table of Contents

Acknowledgements……4

Introduction……5

What is environmental literacy? ……12

Why public schools? …… 15

Why kids? ……17

Why is environmental literacy important? ……19

How can environmental literacy be taught? ……24

Green buildings……26

Sustainable cafeterias……37

School gardens……48

Environmental education curriculum……59

What is an environmental lesson plan? …… 67

How can schools start to implement environmental literacy plans?……82

Conclusion……95

Appendix ……99

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Thank you, thank you, thank you to everyone who has helped me through this process.

Introduction

It was a swelteringly hot day in Washington D.C.'s Anacostia neighborhood. Heat radiated off the blacktop of the schoolyard and the air was thick with humidity. The entire school had come outside to witness the dedication and opening of the new school garden, the first of its kind in the area. Rows of students, teachers and members of the Earth Day Network, the non-profit that funded the project, were lined up facing the garden and the brand new greenhouse. A girl in a wheelchair was in the very front row, right next to a raised vegetable bed. While important people droned on about how proud they were to have this garden in a struggling neighborhood, this girl reached down and grabbed a clump of dirt, rubbing it in her palm and letting it slip through her fingers. When she looked up, her face was streaked with tears. Someone asked her why she was crying and she replied tearfully that never before had she touched the soil. She had spent her entire life confined to her wheelchair and trapped in the concrete jungle of the city. This raised bed in an old and dusty schoolyard had provided her first real contact with the earth.

A co-worker told me this story as we were standing in the very same Anacostia school garden, amid leggy sunflowers and early summer corn. The garden was not much to look at, simply a few large planter boxes and a tiny greenhouse, but amid the dilapidated neighborhood houses and cracked cement of the schoolyard it was a welcoming oasis. This garden represented a little slice of heaven in an otherwise drab city world and it all belonged to the kids and teachers who cared for it. It was then, as I stood in this tiny garden that had brought so much pride to the community, that I realized what a vitally important role schools can play in shaping a student's life. A person is often defined by his

choices and all the information and skills a child learns in school contributes to every decision that student will ever make. In this way, schools have the rare ability to shape not only individual student's values, but also the values and perceptions of entire generations of Americans. In the thousands of public schools across the country, teachers, administrators and staff members provide America's children with the learning tools necessary to build the lens through which they will view the world for the rest of their lives. If students are taught to view the environment as a fragile wonder that we can enjoy but also must protect, they will carry this idea with them into adulthood and it will affect the choices they make for themselves, their families and their communities.

For proof, one must look no farther than this same school garden, in which students who had never left the city before in their lives, much less ever seen a forest or a stream, were begging to be allowed to dig in the dirt and care for the earthworms. It was through this tiny piece of nature that these students were able to learn about the world outside of their concrete-encased lives. As they learned, they were also motivated to take care of the natural world that surrounded them in the garden. A garden is a tiny ecosystem, but it is not a very hard to imagine that the same principle could be applied to the earth as a whole: learning about its many wonders and how to live in harmony with them will make a student more excited to take care of the planet. Students like those at the garden in Anacostia are ready to soak up information, but needed a push in the right direction from a teacher, school, or the community at large. There are students like these kids all over the country, just waiting to be given the opportunity to begin to care for their planet.

The public school system in the United States constitutes an enormous network: about 55 million students and 5 million teachers spend their days learning or working in

public schools.[1] This accounts for about 20% of the population of the United States. As parents send their children off to school each day, they are trusting that this institution, charged with molding the next generation of Americans, will help their children become intelligent, caring citizens. However, this system is currently failing to properly address one of the most important and time sensitive matters in our history. As of 2011, Maryland is the only state that requires public schools to teach environmental lessons as part of their core curriculum.[2] The fact that the environment is being neglected in the vast majority of schools across the nation has measurably harmful effects. In 1993, a survey of incoming college students found that 40% considered taking care of the environment to be an important goal in the future. By 2003, this number had decreased to about 20%.[3] This is hardly surprising, for as of 2010, only 20% of teachers incorporated environmental learning into basic education.[4] Kids are one of the largest untapped resources in the environmental movement's quest to create a sustainable society. It is clear that teaching kids to be environmentally literate is an important task that should be integrated into public education across the country.

Creating this environmentally conscious society however is much easier said than done. Making extreme changes to any public institution, especially the school system, which is constantly plagued by money shortages and ideological controversies, is a difficult proposition that poses many challenges. Why is environmental literacy important? What

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[1] Kats, Gregory. "Greening America's Schools: Costs and Benefits." *Capital E Reports.* 2006. Pg. 4
[2] "Environmental Education Instructional Programs for Grades Prekindergarten-12 Grade." *Office of the Secretary of State of Maryland.* Retrieved July 26, 2011 from http://www.dsd.state.md.us/comar/comarhtml/13a/13a.04.17.01.htm
[3] Karliner, Joshua. "Thinking Big About Ecological Sustainability, Children's Environmental Health, and K-12 Education in the U.S." *Little Green Schoolhouse.* 2005. Pg. 24.
[4] "Why Teach Environmental Education?" *Classroom Earth: A National Environmental Education Foundation Program.* 2008. Retrieved July 28, 2011 from http://www.classroomearth.org/node/251

are the ways in which the American public education system can be changed to emphasize environmental literacy? What programs need to be instituted and how will these programs affect the students, staff, community and environment? How can environmental education be taken beyond the classroom and into a student's future life? Perhaps most challenging of all, how can we make our society care about the environmental education revolution that is critical for the care of our planet? These are the most pressing questions that must be answered if we are to begin to transform one of the largest public institutions in the country.

I first became interested in the role that schools could play in environmental literacy about 2 years ago. I work as a teaching aid in a 2nd and 3rd grade classroom at Sycamore Elementary in Claremont, California. Sycamore is a public school that follows a slightly alternative curricular system in which students are allowed to vote upon certain special paths of study that they would like the class to pursue. The idea behind such a strategy is to allow kids to take more control over their own educations as well as to make the school more focused on learning rather than simply passing standardized tests. Because this curricular strategy differs greatly from mainstream public schools, this is the type of institution in which I would have expected many alternative subjects to be taught, such as environmental education. However, it turned out that this was not the case. As I came to know the school and the classroom I worked in, I realized that there was not a recycle bin in the entire room, on the playground or anywhere that I could see apart from the copy room. When I asked the 8- and 9-year-olds in my class where the recycle bin was, they gave me only a blank stare. They said that their teacher had never mentioned recycling and as far as they knew when they put an item in the trash bin it was the janitor who got rid of

it. As I continued exploring the school, looking for any other signs that the students were receiving any type of education in environmental issues, I found that outside the classroom was a small plot that had evidentially once been meant to be a school garden but was instead full only of weeds. Kids were reprimanded for going near it during recess and redirected instead to the concrete playground. This baffled me, for I had naively expected a liberal and progressive college town like Claremont to demand a greener curriculum for its elementary school students. I soon realized that this was a solvable problem in my classroom, for I helped to start the garden up again (and the class had a lovely harvest last spring) and eventually the class repurposed a large plastic bin to serve as recycling (although they still need reminders to use it). I realized that my students spent the majority of their waking hours in this classroom, where little, if any, reference was made to the natural world or how to live in it sustainably. Although the situation in this particular classroom was not as bad as it could have been, it made me wonder if a well-off school district like Claremont was leaving environmental stewardship out of education, then what was occurring in public schools all over the nation, particularly in less progressive or less well-off districts?

My life gradually began to revolve around finding some answers to this question. I was lucky enough to learn a great deal more about this topic in the summer of 2011 when I received the Claremont Colleges Mellon Foundation Summer Research Grant which allowed me to accept an internship at the Earth Day Network: a non-profit organization located in Washington D.C. that is committed to advancing environmental conservation

through education, policy and public awareness events.[5] This organization grew out of the first Earth Day in 1970 and the organization's founder was Senator Gaylord Nelson, who was one of the most influential planners of this celebration.[6] His enthusiasm led to an event that inspired 20 million Americans to participate in demonstrations and teach-ins for environmental awareness.[7] This same enthusiasm has been shown on April 20th each year since. Today, the Earth Day Network works on such diverse issues as global water problems, public education, and climate change as well as the simple celebration of nature and all that it has to offer. Each year, the Earth Day Network plans and executes events to celebrate April 20th all over the country, including one of the largest events on the National Mall in Washington D.C. For the rest of the year, the organization writes environmental education curriculum for grades K-12[8], works on Capitol Hill to encourage the passage of environmental legislation of all types[9], and works on other public campaigns such as the Billion Acts of Green Campaign[10], which allows people to register sustainable acts online and was used at the Conference of the Parties in Durbin, South Africa to lobby for international environmental awareness.

I worked in the education department of this small but diverse office. My department consisted of only three full-time staffers and two interns but the work that this department has accomplished over the past forty years has earned the organization its rightful reputation as a leader in environmental education. My duties varied, but I spent

[5] www.earthday.org
[6] Clark, William; Kates, Robert; McGowan, Alan; O'Riordan, Timothy. "The Legacy of Earth Day: Reflections at a Turning Point." *Environment* Vol. 37, No 3. (1995). Pg. 8.
[7] Ibid.
[8] http://edu.earthday.org/
[9] http://www.earthday.org/program/policy
[10] http://www.earthday.org/earth-day-2011

the majority of my time writing blogs for the earthday.org website and crafting and editing lesson plans that were then posted online for teachers to use. The culmination of the office's work that summer was a 350-page online booklet consisting of 25 lesson plans pertaining to sustainable transportation. These lesson plans were in such diverse subjects as science, literature, economics and art, among others. By helping to write these plans, I came to appreciate the variety of ways in which environmental learning can be integrated into the classroom. I also wrote and designed short pamphlets about how to green a school, such as through the farm-to-school program, which connects schools with local farmers so that fresh produce and meat can be served in the cafeteria instead of frozen foods from thousands of miles away. Through all of this work, I learned a great deal about the relatively new field of environmental education and its potential to shape future generations. However, what I was always disappointed to discover was that very few of the amazing strides that have been made in the field of environmental lessons and green schools were actually being played out in America's public school classrooms.

That then is the problem that needs to be addressed: there is an undeniably large amount of potential to teach environmental literacy in the United States, but to date very little action has been taken to do so. Thus, it became my goal to explore not only the potential benefits of teaching environmentalism in schools, but they ways in which to do this and how they can be logically integrated into the U.S. system. By looking at a variety of school greening methods as well as educational philosophy and the history of humans' interactions with the environment, I intend to explore exactly how the public education system can be used to create an environmentally literate society and what impacts this could have upon future generations. As many believe that we are fighting the clock against

environmental disaster, it is vital that initiative is taken to teach young people about the earth we all inhabit and how to care for it in a sustainable way. What better place to start than the institution where 55 million kids spend seven hours a day learning how to become responsible and intelligent adults?

What is Environmental Literacy?

To understand why public schools are the best place to create an environmentally literate community, it is important to establish a few working definitions of key terms that are vital to the environmental movement. To define environmental literacy, it turns out, is much easier said than done. In the first place, the idea of literacy is a tricky one, for it is a relatively new word in the English language. Until the late 1800's, literacy was only used in the form of "illiteracy" and in all cases was only used to describe one who could not read or write.[11] Thus, there has always been much confusion over using the term literacy to describe something other than basic reading and writing skills.

Today however, the definition of 'literate' has been expanded to "an educated person, one who can read and write"[12] and it is this idea of being well educated that environmental scholars have latched onto as the basis for a definition of environmental literacy in particular. The idea of environmental literacy as a scholarly term was first raised in the 1960s. It was at this time that environmental education was first becoming a well-supported field. The first definition of environmental literacy defined it as "the capacity to perceive and interpret the relative health of environmental systems and to take

[11] Roth, Charles. "Environmental Literacy: Its Roots, Evolution, and Directions in the 1990s." *ERIC Clearinghouse for Science, Mathematics and Environmental Education.* Ohio State University Publications: Columbus. (1992). Pg. 12.
[12] Merriam Webster Online Dictionary. Retrieved September 25, 2011 from http://www.merriam-webster.com/dictionary/literate

appropriate action to maintain, restore, or improve the health of those systems."[13] This seems to be an appropriate definition, but I believe it lacks one small aspect that may be the most important issue for modern environmental education; that is learning about how human systems interact with the planet. Thus, being environmentally literate involves not only environmental awareness, but also societal awareness about our own actions as humans and how it is possible for these two systems to coexist successfully. From this awareness, environmentally literate citizens would act in everyday life with this harmony in mind. Of course, a student will not learn to be environmentally literate overnight, but a series of steps can be identified on the road to environmental literacy. The first is *awareness*: the simple knowledge that there is a relationship between humans and their environment. Hopefully, most American citizens have such a basic awareness and have thus completed step one on the path to environmental literacy. Next comes *knowledge*, which means that one can explain and analyze natural processes and how humans interact with those systems. *Attitude* is achieved next, meaning that the student shows concern for the environment and the way humans are impacting it. Next are *skills,* meaning that one has learned how to protect the environment by changing their behaviors in response to problems. Finally, one is considered environmentally literate if he or she takes *action* to solve environmental issues and urges others to do the same. These actions could be as small as buying locally grown produce or walking to work, but they show that the learner has a firm grasp of the way that humans and the environment interact and the student has

[13] Roth, Charles. "Environmental Literacy: Its Roots, Evolution, and Directions in the 1990s." *ERIC Clearinghouse for Science, Mathematics and Environmental Education.* Ohio State University Publications: Columbus. (1992). Pg. 17.

the motivation to work for change.[14] It may take years to achieve this level of environmental literacy, but it is important to be able to measure a student's progress throughout the process.

It is also critical to define environmental education, which is slightly more complex than the term implies simply because it must be so multidisciplinary in order to be successful. Scholars have described modern environmental education to be *for* the environment instead of *in* and *about* the environment,[15] however this definition seems far too limiting, for it restricts environmental education to the classroom. Just as all subjects taught in schools, environmental studies should be comprehensive enough so that it can be applied *outside* of the classroom. After all, what is the point of teaching a subject that is not meant to be applied outside of school? Thus, environmental education needs to address much more than just classroom learning and should be *in, about* and *for* the environment. Perhaps a more all-encompassing way to express environmental education is as a set of lessons that teach students how to, "sustain our planet and its resources for future generations…[thus] producing well informed and environmentally active adults."[16] This means that environmental education needs to be taught not only through classroom lessons but also through experiences, which allow students to make connections to their everyday lives. Because an "infusion approach is the most effective way to proceed"[17] environmental education "must be far broader than words on a page or images on a

[14]Miller, Sean. "Sustainability Education and Green Schools." *Earth Day Network.* 2011.
[15] Johnson, Edward; Mappin, Michael. "Changing Perspectives of Ecology and Education in Environmental Education." *Environmental Education and Advocacy.* Cambridge: Cambridge University Press. (2005). Pg. 3.
[16] Palmer, Joy; Neal, Philip. *The Handbook of Environmental Education.* New York: Routledge Press. (1994). Pg. 3.
[17] Johnson, Edward; Mappin, Michael. "Changing Perspectives of Ecology and Education in Environmental Education." *Environmental Education and Advocacy.* Cambridge: Cambridge University Press. (2005). Pg. 4.

screen."[18] By making the entire school institution, including the physical space, food served on campus, outdoor activities and curricular planning relate to the theme of environmental awareness, it is possible to make environmental literacy an important topic both locally (within the school environment) and globally (in the community and the student's adult life).[19]

Why Public Schools?

There are, of course, a variety of ways to educate one's children in America. Although both private schools and home schooling are on the rise, I have chosen the public school system as a framework for environmental education for a variety of reasons, not least of which is because it is a system that is very near and dear to my heart. I spent 13 years of my educational career in the public school system and I truly believe that I learned much more than simply math and reading. Among students from all different backgrounds, socioeconomic classes, and levels of dedication to their educations, I learned exactly how different the populations we live in really are. Not only did this help me to develop my academic dreams for the future, but also firmly cemented in my mind the importance of living in harmony with others. Although I had no environmental education to speak of (despite living in an agriculturally dominated community) I came away from school with the realization that we all only have one Earth to share and we had better figure out a way to live together on it and do so quickly.

The public school system is an integral part of American democracy because it is

[18] Thompson, Patricia. *Environmental Education for the 21st Century.* Peter Lang Press: New York. (1997). Pg. 280.
[19] Cole, Anna. "Expanding the Field: Revisiting Environmental Education Principles Through Multidisciplinary Frameworks." *Journal of Environmental Education.* Vol 38, No. 2. (2007). Pg. 36.

meant to achieve that very goal: to provide the education a student needs to become a fully functioning member of our society. This has been the idea behind the system since its creation because, "the founders of the United States recognized that universal, free public education was the cornerstone of democracy [and used] schools to transform our nation's youth into fully contributing citizens."[20] Unfortunately, while the inspiration was present, in practice, the school system has not always treated all students fairly. Until the middle of the 19th century, only an elite, Caucasian population attended schools and many school-aged children were left by the wayside.[21] However, the educational revolution of the 1860s and 70s created a much more inclusive system in which, "the one room schoolhouse was abandoned in favor of large schools that opened their doors to all and organized students on the basis of age and grade. Attendance laws made schooling mandatory, and the United States emerged with the first system of universal public education."[22] Throughout the system's history there have been many changes to teaching philosophy and learning requirements; perhaps the most well known was as a result of the start of the Space Race in 1957. After the Russian's launch of Sputnik, officials worried that the American school system was not preparing students for competition with the threatening Soviet bloc.[23] To solve this issue, an intense curricular overhaul was ordered that mandated more math and science lessons for students of all ages.[24] This new program encouraged schools to be more

[20] Joyner, Edward. "Mobilizing Schools and Communities to Develop Ethics and Social Responsibility." *Common Schools, Uncommon Futures: A working Consensus for School Renewal.* Edited by Barry Kogan. Teachers College Press: New York. (1997). Pg. 74.
[21] Hawkins, Donald; Vinton, Denis. *The Environmental Classroom.* Prentice-Hall, Inc.: Englewood Cliffs. (1973). Pg. 15
[22] Ibid.
[23] Ibid.
[24] Ibid.

focused upon learning and application rather than just memorization of facts. [25] Student progress in math and science did show improvement when it was stressed in the classroom and new theories on learning that emphasized practical uses for skills taught in school were integrated in all grade levels across the country.[26] It is clear that when an educational issue is brought into the public eye, kids benefit from the extra attention.

For this reason, I feel the public education system is the most obvious institution in which to make environmental literacy a priority. Public schools reach the highest percentage of children possible and are also central parts of a community, integrating adults into the institution. In fact, it has been suggested that "few parts of our biographies are untouched by the institution of schooling."[27] Public schools also serve as meetinghouses, polling places, and sports venues. The entire community is likely to view a public school as an important town institution.[28] Thus, any environmental knowledge a child learns or school greening project that they witness will ultimately be transmitted to the rest of the community. In this way, schools have the ability to reach not only students, but also their parents, extended family and entire communities. The public school system is one of the building blocks of the United States and throughout history a common "trait of the American people has been to look to education to solve each new problem of society."[29]

Why Kids?

That being said, why are children, rather than adults, the primary focus of an

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[25] Hawkins, Donald; Vinton, Denis. *The Environmental Classroom.* Prentice-Hall, Inc.: Englewood Cliffs. (1973). Pg. 15
[26] Ibid.
[27] Stevens, Mitchell. *Kingdom of Children: Culture and Controversy in the Homeschooling Movement.* Princeton: Princeton University Press. (2003). Pg. 10.
[28] Ibid.
[29] Hawkins, Donald; Vinton, Denis. *The Environmental Classroom.* Prentice-Hall, Inc.: Englewood Cliffs. (1973). Pg. 15

environmental literacy movement? I have chosen to focus upon the education of children because learning to live sustainably is a life long transformation and a life long commitment. It is absolutely vital that our population learns to make long-term changes to our lifestyles because the damage we have already done to the natural world will not be repaired overnight. The entire mindset that Americans have about the relationship humans should have with the earth needs to change. We can no longer subscribe to the idea that our role is to subdue and dominate the rest of the planet.[30] The state of the natural world is continuing to spiral out of control and thus it is important that we plan for the future and change our role from that of domination of nature to peaceful cohabitation of the Earth.[31] Some people all too easily brush off environmentalism as simply the fad of the 21st century, for it has become a bit of a fashion statement. Starting in the 1980's, "becoming environmentally friendly, or at least *appearing* environmentally friendly started to look good for a company's bottom line."[32] From designer reusable shopping bags to hybrid Priuses, the environmental movement has done well in branding its cause.[33] Toyota has helped its decidedly unsexy hybrid car to "gain affluent association in-use through celebrity adoption" and advertising.[34] However, environmentalism needs to go much deeper than transforming our consumerist impulses if real progress is to be made. Thus, it is important to involve children in this revolution because they have yet been mentally polluted with ideas of environmental domination and consumerism.

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[30] Hawkins, Donald; Vinton, Denis. *The Environmental Classroom.* Prentice-Hall, Inc.: Englewood Cliffs. (1973). Pg. 4.
[31] Ibid.
[32] Vos, Jacob. "Actions Speak Louder Than Words: Green washing in Corporate America." *Notre Dame Journal of Law, Ethics and Public Policy.* Issue 1. (2009). Pg. 674.
[33] Hurth, Victoria. "Creating Sustainable Identities: The Significance of the Financially Affluent Self." *Sustainable Development.* Vol 18. (2010). Pg. 127.
[34] Ibid. .

Children are also at a point in their developmental process that makes childhood an ideal time to foster new skills and morals. The brains of children and teens are uniquely equipped to absorb new information, identify patterns in what they are learning and apply them systematically and easily to their lives.[35] This is best shown through a child's acquisition of language. Although psychologists still study and debate why it is that children are able to learn and utilize language effectively so early on in their lives, one thing is clear: infants are able to negotiate an extremely complex language system, identify patterns and create categories of words to begin to form coherent sentences much quicker than any adult can learn a language through intense study.[36] By the pre-teen years, they have mastered this extraordinary linguistic system that they will use for the rest of their lives. It would logically follow then, that because children can accomplish this feat, other concepts taught in childhood might be just as successfully learned and incorporated into daily life. Thus, childhood is the ideal time to begin to teach for environmental literacy.

Why Is Environmental Literacy Important?

Teaching children from an early age certainly will impact the rest of their lives, but why should the environmental movement be concerned with this fact? Why is environmental literacy important enough to consider changing the country's educational system to advance it? This is a question that is very difficult to answer, for it is most basically a question of values. However, by examining environmental history, it is possible to demonstrate the importance of environmental literacy for anyone who wants to peacefully and safely inhabit our planet. Environmental history and the history of humans

[35] Saffran, Jenny. "Statistical Language Learning: Methods and Constraints." *Current Directions in Psychological Science.* Vol 12, No. 4. (2003). Pg. 110.
[36] Ibid.

have been long intertwined because "ever since man first appeared on this earth, he has been polluting his environment. As soon as he acquired tools and discovered fire, he became more than just another element of the natural order. He began to change his environment, to control it, to dominate it-for better and for worse." The earth is finite and thus it seems obvious that the planet may someday run out of land for us to live upon and systematically destroy with gluttonous consumption.[37] To move away from this human attitude of domination and expansion, it is vital that we understand the world we live in, because otherwise it is all too easy to take our natural environment for granted and continue on a course of destruction for personal gain.[38]

The idea of environmental literacy requires an entirely new way of perceiving the purpose of education and the concept of a human's role on earth. At the core of the idea of environmental literacy is the concept that individualism is *not* the most desirable quality in an educated individual.[39] The idea of the individual as the single most important actor shaping the actions of societies and even the world population leads to "thinking of intelligence, creativity and moral judgment as individual attributes. The pursuit of self-interest and the sense of being separate from nature follow from this view of the autonomous individual."[40] This is a famously held viewpoint of Americans, for this country was based upon the idea of self-autonomy and "pulling yourself up by your bootstraps." For this reason, the way that American children are educated usually emphasizes this same

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[37] Saffran, Jenny. "Statistical Language Learning: Methods and Constraints." *Current Directions in Psychological Science.* Vol 12, No. 4. (2003). Pg. 110.
[38] Hawkins, Donald; Vinton, Denis. *The Environmental Classroom.* Prentice-Hall, Inc.: Englewood Cliffs. (1973). Pg. 4.
[39] Bowers, C.A. *The Culture of Denial.* State University of New York Press: Albany. (1997). Pg. 7.
[40] Ibid.

ideal.[41]

Because the education system has been built around American individualism, certain types of learning are emphasized above others. C.A. Bowers, professor and author of many books concerning the current ecological disaster, identifies two main types of knowledge: high-status and low-status knowledge.[42] Low-status knowledge is that which is not considered important in American culture and can generally be described as any knowledge not pertaining to "the modern individualistic and technologically oriented culture of change."[43] High-status knowledge is exactly the opposite: it deals with progress and using technology to advance American ideals.[44] This is much more likely to be taught in schools because it fits well within the typical American attitude.[45] The importance placed upon this type of knowledge is critical when considering the necessity for environmental literacy because, "the introduction of millions of tons of toxic chemicals into the environment, as well as the impact of modern technologies on fisheries, forests, topsoil, aquifers, and weather systems now make it increasingly difficult to ignore the connections between the high-statues forms of knowledge promoted by public schools and universities and the ecological crisis. The rapid increase in human population, along with the spread of moral disintegration among previously stable and relatively self-reliant cultures, are also important contributors to the decline of the Earth's natural systems. Both of these worldwide trends have also been heavily influenced by the West's high status forms of knowledge. In effect, the changes in the Earth's chemistry and biological processes…bring

[41] Bowers, C.A. *The Culture of Denial.* State University of New York Press: Albany. (1997). Pg. 1.
[42] Ibid.
[43] Ibid. Pg. 7.
[44] Ibid.
[45] Ibid.

into question in the most profound and urgent way the forms of knowledge that our education institutions equate with modern progress."[46] It is important to acknowledge that both high and low status forms of knowledge are necessary in our society but in essence, the ecological crisis that we are facing can be attributed at least partly to the way we educate children and the morals that we instill in them at an early age which will remain the baseline for their ethical development.[47]

By this logic, having an environmentally literate society has the potential to act as a catalyst for change. Environmental literacy is important because it allows one to view environmental issues with a more hopeful air, for by understanding these issues it is easier to see that all hope is not lost and that the planet's problems are solvable. This will undoubtedly spur young people to work towards change. In a study of graduating college students who were required to take a course in environmental literacy and action before graduation, their attitudes towards environmental problems were shown to change dramatically after the course was administered.[48] Beforehand, many of the students believed that environmental problems were too enormous for them to comprehend or do anything about, so they instead chose to give up on affecting change in that sector.[49] However, after the course, they saw environmental issues as serious but solvable if they worked towards making changes to their lives and organizing others to do the same.[50] This course allowed these students to be more than just "armchair pontificators,"[51] that is to say they were inspired for action rather than simply speaking knowledgably without any real

[46] Bowers, C.A. *The Culture of Denial.* State University of New York Press: Albany. (1997). Pg. 2.
[47] Ibid.
[48] Rowe, Debra. "Environmental Literacy and Sustainability as Core Requirements: Success Stories and Models." *Teaching Sustainability at Universities.* (2002). Pg. 2.
[49] Ibid.
[50] Ibid.
[51] Ibid.

conviction. This call to action is perhaps the most important reason why environmental literacy is necessary, for it "holds enormous potential for radically changing the way environmental issues are conceived. The emphasis on action as the ultimate outcome and the suggestion that environmental literacy should be considered as basic and universally desirable as reading and writing argue for a reconceptualization of the way citizens approach the world, and what constitutes their most fundamental and most important interests."[52]

Living in an environmentally sustainable way does not have to include extreme changes; in fact for most people there is not one defining moment that makes a person suddenly want to radically alter their unsustainable lifestyle. In general, being environmentally conscious is a continuous process of growth and small changes, which makes it even more of an important one.[53] This idea stresses the fact that a push for environmental literacy must occur at all ages and throughout life to be effective.[54] People who consider themselves concerned for the state of the environment and who want to make a sustainable lifestyle a priority often seem to be similar in that they "have a childhood rich in outdoor experiences and sensory awareness of the natural world, followed by more 'latent' teenage years, and then a reawakening of enthusiasm for the quality of the environment in nearly adult life."[55] Although I would advocate *not* wasting those teenage years and rather taking advantage of every learning opportunity to make progress towards environmental literacy, the fact remains that even in adulthood, this type

[52] St. Clair, Ralf. "Words for the World: Creating Critical Environmental Literacy for Adults." *New Directions for Adult and Continuing Education.* No 99. (2003). Pg. 70
[53] Palmer, Joy; Neal, Philip. *The Handbook of Environmental Education.* New York: Routledge Press. (1994). Pg. 9.
[54] Ibid.
[55] Ibid.

of learning is still possible. Environmental literacy is a process with enormous potential for creating change, but it must be made a priority in public education to have an impact in society.

How Can Environmental Literacy be Taught?

Learning happens in a variety of ways and as such, teaching techniques must be equally varied. When faced with a crisis, schools most often jump to add curricular initiatives that are supposed to make the problem go away instantly. Although adjusting curricula to changing societal issues is necessary overtime, adding environmental lessons to an already overburdened learning schedule increases "the dangers of schools latching onto a new idea that is just another educational fad"[56] and will thus be less effective. Unless environmental education is integrated on a variety of levels, it will probably go the way of many other fads: forgotten or simply a memory to be laughed about in the future.[57] Therefore, environmental education must be used as an agent of transformation, so that it is not just arbitrarily inserted into the school day but rather deeply engrained into existing curricula. In other words, teaching for environmental literacy must be embedded into established school functions besides just the curriculum, because the environmental crisis "is first and foremost one of mind, perception, and values."[58]

To create an education system that teaches values and perceptions of the world, one must recognize that learning takes place during every single moment of a child's life.[59] Information learned directly from a teacher in a classroom is obviously important, but

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[56] Hawkins, Donald; Vinton, Denis. *The Environmental Classroom.* Prentice-Hall, Inc.: Englewood Cliffs. (1973). Pg. 22.
[57] Ibid.
[58] Orr, David. *Earth in Mind: On Education, Environment, and the Human Prospect*. Island Press: New York. (1994). Pg. 27.
[59] Heimlich, Joe; Falk, John. "Free-Choice Learning and the Environment." *Free Choice Learning and the Environment.* Edited by: Heimlich, Joe; Falk, John; Foutz, Susan. AltaMira Press: Plymouth. (2009). Pg. 11

scholars have noted that "learning as a lifelong natural process happens consciously, subconsciously, and often only coincidentally with the intentions of the individual."[60] It is clear that a trip to a nature park will teach kids about the environment, but who is to say that they have not already been learning about nature by observing their school playground, backyard, or city of residence?[61] Comprehending exactly how people learn can be difficult, because so much of our knowledge is amassed through interactions that we do not deem to be instrumental in our lives, such as simply observing someone else complete a task or through our own trial and error.[62] Learners will most likely not recognize that they are adding to their massive mental database of information even as their brain is recognizing and storing information.[63] However, administrators, teachers and government officials, who have been instructed with the task of designing and carrying out the function of a school absolutely *must* recognize this because their ignorance has the very real ability to shape the values and perceptions of every child who passes though their school. In terms of environmental literacy, we must look at all the ways in which a student interacts with his or her school environment and evaluate the methods through which we could make each of those systems an opportunity for learning about sustainable lifestyles. I have identified four main categories of a school that can be addressed in this manner. The first is the school building itself, for kids may end up spending more waking hours at school than just about any other space. Therefore, it is inevitable that they will be observing, evaluating and learning from the built environment around them. Food is another integral

[60] Heimlich, Joe; Falk, John. "Free-Choice Learning and the Environment." *Free Choice Learning and the Environment.* Edited by: Heimlich, Joe; Falk, John; Foutz, Susan. AltaMira Press: Plymouth. (2009). Pg. 11.
[61] Ibid.
[62] Ibid. Pg. 12.
[63] Ibid. Pg. 13.

part of the school experience. Although the proportion of meals a child eats at school can vary, some schools serve as many as three meals a day, so the education system has the potential to be providing kids with the only nutrients they receive during the school week. The schoolyard (as in the case of primary school) or the campus (for secondary education) is also an important part of the school experience and plays a role in how a student learns to view and interact with the natural environment. Finally, the curriculum must be used as a tool to teach environmental literacy because this will likely be the most tangible manner in which one is able to measure the success of a program for environmental education. As it turns out, each of these distinct sectors of the school have much to gain from becoming more environmentally focused: the students, teachers, and taxpayers will benefit from emphasis placed upon environmental literacy.

Green Buildings

Many Americans spend the majority of their days inside. As modern humans, we thrive on creating a built landscape around ourselves, making the building in which one works into something of a habitat. For this reason, it would seem to be of utmost importance that buildings are comfortable, safe, and offer good working environments. Many businesses have begun to lean in this direction; even new buildings at Pomona College have been built with solar panels, rooftop gardens and large, day lighting windows. If people like me are given the opportunity to spend our days in buildings such as these, why are children, teachers, and administrators in many public schools not provided these same working conditions? If a school is to teach environmental literacy to its students, it is vital that the buildings they are using during these lessons reflect the same messages they are instilling in students. Environmentally friendly buildings serve not only as teaching

tools for students, but also can be a way to improve the learning environment necessary for children to learn all subjects. The benefits of green building techniques are endless and the drawbacks are few and far between. This is a crucial part of the environmental education movement that many have overlooked.

The average American public school was built 42 years ago.[64] Most schools take quite a lot of abuse and although some have coped well with thousands of children passing through their doors, others have obviously not. In the most recent survey of the physical quality of American schools carried out in 2005 by the U.S. Department of Education, 50% of schools were rated as in "less than adequate condition" and 25% needed "extensive repairs."[65] More specifically, 20% of schools in America have poor air quality within their buildings.[66] These are the buildings in which students as young as 5 years old are supposed to be learning life skills. By the time that a student graduates from high school, he or she will have spent more than 24,000 hours in school buildings that are often uncomfortable, unhealthy, unsustainable and not conducive to learning. In 2011, 1.3 billion dollars was cut from the budget of the Department of Education, which is partially to blame for the fact that nearly half of all students in America are sent to schools that are in varying states of disrepair. School children deserve better.

A few have gotten what they deserve. There are a number of schools in the U.S. that have been made more sustainable, so it is possible to analyze the benefits and drawbacks of

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[64] Global Green USA. "Do Green Schools Improve a Student's Academic Performance?" *Green Schools Initiative. 2005. Pg. 1.*
[65] Lewis, Laurie; Snow, Kyle; Farris, Elizabeth; Smerdon, Becky; Cronen, Stephanie; Kaplan, Jessica. *Condition of America's Public School Facilities.* U.S. Department of Education. Washington, D.C. 1999.
[66] "Condition of America's Schools." United States General Accounting Office. 1995. http://www.gao.gov/archive/1995/he95061.pdf.

building green schools or remodeling existing ones. Schools that take steps to become environmentally friendly will on average use 33% less energy than normal schools.[67] The most efficient ways to save energy are by switching to high performance light bulbs, adding more windows to take advantage of natural daylight and installing better insulation to reduce the use of heaters and air conditioners.[68] These types of changes also tend to reduce emissions from schools (especially those from heating) about 33%. Because the United States is responsible for a whopping 25% of all emissions *worldwide* and there are more than 93,000 public schools in the country, reducing emissions in those buildings could really make a significant difference in the world's air pollution and climate change problems.[69] The use of other limited resources can also be greatly diminished; green schools on average use 32% less water than traditional schools.[70]

These green schools do not just benefit the environment; in fact some of the most strikingly positive characteristics of green schools are their impact on students, teachers, and administrators. The health of those who work in the building is of the utmost importance and green schools can dramatically improve their occupants' health. Most students spend the majority of their time inside the classroom as opposed to outside in the schoolyard; so one way in which green schools can improve student health is by improving indoor air quality. Almost no public schools have rules about air quality *inside* buildings. Studies have shown that air quality tends to be worse inside buildings rather than outside, so even if a school is located in a relatively clean area, the air inside may still be very

[67] Kats, Gregory. "Greening America's Schools: Costs and Benefits." *Capital E Reports.* 2006. Pg. 6.
[68] Ibid.
[69] National Center for Education Statistics. 2005. http://nces.ed.gov/pubs2007/overview04/tables/table_2.asp
[70] Kats, Gregory. "Greening America's Schools: Costs and Benefits." *Capital E Reports.* 2006. Pg. 9.

harmful.[71] Green schools provide better ventilation and control temperature more effectively with better insulation, cleaner power sources and more windows. With these types of changes, schools have observed an average of 41% fewer problems with asthma, flu, headaches, and other respiratory illnesses in teachers and students. This has led to fewer sick days taken by all people working and learning in the building and dramatically increased productivity because students came to school more often and were not distracted by troubling symptoms and uncomfortable working conditions.[72] Greening schools ultimately increases the amount of time a student spends learning and thus students in green schools have the potential to be able to absorb more information per year than other students because they are present more often and less likely to be ill. Teachers are then able to teach a wider variety of material, instead of simply teaching a student the basics necessary to pass standardized tests. This extra time could be devoted to environmental curriculum that too often is pushed aside in a school's quest to raise standardized test scores.

Luckily, with a more comfortable and clean environment, test scores increase as well. A school in Washington State reported that state standardized test scores jumped by 5% after the building was greened.[73] Increasing day lighting seems to be one of the most effective techniques to improve student learning because students in classrooms with more natural light progress 20% faster in math and 26% faster in reading than students in traditional classrooms.[74] This is one of the easiest green techniques to incorporate into a new building by simply adding more large windows. Student progress also was aided

[71] Kats, Gregory. "Greening America's Schools: Costs and Benefits." *Capital E Reports.* 2006. Pg. 10.
[72] Ibid. Pg. 12.
[73] Ibid. Pg. 13.
[74] Ibid.

because teachers are more likely to want to stay through their contracts in green schools. Thus, students have more stability in their education and tend to do better on tests and in subsequent grade levels.[75]

Green schools also teach environmental lessons every time that a child sets foot in the building. David Orr wrote that traditional "campus architecture is crystallized pedagogy that often reinforces passivity, monologue, domination, and artificiality…students are being taught in various and subtle ways beyond the overt content of courses."[76] He writes that typically students only learn by sitting, watching and learning inside of four dreary walls. This, he insists, is partially responsible for the way students feel about their education: that it does not really have anything to do with real life and is only pertinent inside of the classroom.[77] However, in green schools, environmental literacy is brought directly into the classroom and students are surrounded by environmental lessons in practice every day. By placing solar panels on the roof of the school, for example, not only is the administration inviting teaching moments at recess when a child reacts to what they can see on top of the school, but teachers can also actively use the solar panels as a lesson plan. Science classes could study the mechanisms that make solar panels work and social studies classes could study local or federal government policies on alternative energy. A tour or treasure hunt around the school could inform students about where the power that turns on their classroom's lights comes from or how a green roof helps keep them warm in the winter. Children are observant and will take in everything around them;

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[75] Gordon, Douglas. "Green Schools as High Performance Learning Facilities." *National Clearinghouse for Educational Facilities.* 2010. Pg. 2.
[76] Orr, David. *Earth in Mind: On Education, Environment, and the Human Prospect*. Island Press: New York. (1994). Pg. 14.
[77] Ibid.

so if their school building is environmentally friendly, they will notice and ask questions to better understand why this is an important feature, showing that "academic buildings are not neutral, aseptic factors in the learning process."[78] Schools should also involve the students directly in greening the school, whether that is done through a science class maintaining and monitoring solar panels, or having younger students tend to a garden or replace normal light bulbs with high efficiency ones. A building can be an important teaching tool, especially when the students spend such an enormous portion of their daily lives learning inside of it. Unfortunately, this idea is not widely acted upon because, according to Orr, "we have assumed, wrongly I think, that learning takes place in buildings, but none occurs as a result of how they are designed or by whom, how they are constructed and from what materials, how they fit in their location, and how-and how well- they operate."[79]

These elements of a school's built environment can also teach the larger community about environmental issues and therefore can reach a much larger group of people than just the students. One effective technique is for a school to post placards describing what makes their architecture environmentally friendly and how it benefits the community it serves. Signs such as these will not only be read by students but also staff, parents and other community members that visit the school. Thus, because schools often act as a center of community life (for kids, but also for governmental meetings, polling places, clubs, etc.) greening a school building can also green a community's attitudes.

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[78] Orr, David. *Earth in Mind: On Education, Environment, and the Human Prospect*. Island Press: New York. (1994). Pg. 112.
[79] Ibid. Pg. 113.

Those who are skeptical about the benefits of green schools usually point to their costs of construction as a major drawback. It is undeniably true that it takes money to remodel existing buildings or build new schools. However, there is money allocated in the federal budget for the maintenance and construction of schools and this money could be used to build new schools in a more sustainable manner. Slightly more money is needed up front to build an entirely new green school than a traditional one. A study of 30 different green schools across the nation found that green schools cost about $3 more per square foot to build than normal schools (or about 2% more).[80] However, over the course of 20 years, it was found that the combined savings in energy consumption, water use, teacher retention and student health will directly save the school about $12 per square foot of green building space.[81] At this rate, a green school would pay for itself in only 5 years. This study estimated that after 20 years, the savings from a green school could pay for 250 computers or two new teachers.[82] The costs may be greater in the beginning, but in the long run, green schools benefit the education system. As Gregory Kats, a leader in the study of sustainable schools confirms: "building green schools is more fiscally prudent and lower risk than continuing to build unhealthy, inefficient schools."[83] Unfortunately, there are significant roadblocks to inexpensive green construction, partially because our society has placed enormous importance upon making a green building legitimate in the eyes of the public. The U.S. Green Building Council has capitalized upon this need for recognition and thus today many view the LEED (Leadership in Energy and Environmental Design) certification system as the best way to determine whether or not a building is sufficiently

[80] Air Quality Sciences. "Green Schools." *Air Quality Sciences Inc.* 2009. Pg. 6.
[81] Kats, Gregory. "Greening America's Schools: Costs and Benefits." *Capital E Reports.* 2006. Pg. 2.
[82] Ibid. Pg. 22.
[83] Ibid.

sustainable. LEED is a standard of certification that outlines many different ways in which a building could either be built from the ground up or renovated so that it is more environmentally friendly and encourages those who live or work inside to act in a sustainable manner. Before this system was developed, there were almost no regulations about what could be considered a "green" building.[84] However, when LEED came on the scene in 1998, it "tapped a pent-up demand for reliable information with a rigorous rating system and a checklist for going green."[85] LEED certification was originally designed to evaluate all buildings with the same criteria, but as it grew in popularity, the committee decided to diversify and create multiple protocols for different types of buildings.[86] The LEED certification process for schools is slightly different from that of an office building because of the unique needs of a school and the typical size and lay out of academic buildings.[87] Although LEED has tried to make its system useful for schools, I do not think that a protocol originally designed for office buildings is the most effective way to evaluate and certify green schools because the process does not acknowledge a school's specific needs.

The categories that LEED outlines as critical in the process of creating a green school include water efficiency, use of energy, sustainability of materials, innovative design, location, air quality, and much more.[88] Each of these items is extremely important to making a building a sustainable working environment and this list could function very well

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[84] Shendler, Auden and Udall, Randy. "LEED is Broken- Let's Fix It. "i*Green Build: The Voice of Sustainable Design and Construction*. http://www.igreenbuild.com/cd_1706.aspx
[85] Ibid.
[86] "LEED 2009 For Schools: New School Construction and Major Renovation." *U.S. Green Building Council.* (2011). Pg. xi.
[87] Ibid.
[88] "What LEED Measures." *U.S. Green Building Council.* 2011. www.usgbc.org/DisplayPage.aspx?CMSPageID=1989

as a reference for schools wishing to make sustainable changes. Simply taking one item on this list and making it a priority for the school would be an extraordinary accomplishment, especially with the limited funds and support that some communities face. However, this is not how the LEED certification process works. Instead, a school must plan their building around an enormous number of these sustainability 'requirements' because the process is based upon a point system. Each sustainability item has a different point value. The number of points that a school receives dictates the level of certification that it will be granted-- certified, silver, gold, or platinum.[89] A school must attain at least 40 points to be "certified," which is the lowest level of prestige within the system.[90] Most of the items on the point list are worth only 1 point, so a school must adhere to *many* of the sustainability "necessities" in order to receive a certification. Additionally, from the very beginning of the project, the LEED certification team must be involved with the school because it must access the blueprints and evaluate the construction progress. This is an exorbitantly costly process that can add up to tens of thousands of dollars depending upon the size of the project, in addition to the cost of the renovations or new construction.[91]

The pricing of LEED certification has been very poorly reported and there have been many studies that have been published with the intent of showing how economical it is to build green, LEED certified buildings.[92] While many of these studies hold a pro-sustainability stance, some, including one of the most popular and well known by the U.S. General Services Administration, failed to account for any of the fees that certification

[89] "LEED 2009 For Schools: New School Construction and Major Renovation." *U.S. Green Building Council.* (2011). Pg. vii.
[90] Ibid.
[91] "Building Design and Construction Fees." Accessed October 8, 2011 form http://www.gbci.org/main-nav/building-certification/fees/bdc.aspx
[92] Ibid.

requires.[93] This is essentially like "getting a new car price quote without the engine."[94] A school deserves know upfront what type of monetary commitment they are making because it has been estimated that the fees for the certification of a 10,000 square foot building can add up to $50,000 or more.[95]

These costs are a factor that must be taken in to consideration when reviewing a construction project because money would likely have to be diverted to pay for the certification fees. One of the most environmentally friendly buildings in the Midwest is not LEED certified and by avoiding this certification costs, the company was able to use the additional saved money on *more* sustainable features.[96] This shows that one of the most dangerous parts of the LEED system is its ability to "cannibalize funds that otherwise could be used to improve the building."[97] Because the fees required to simply receive the certification are so enormous, it is unlikely that public schools could rationally make this a part of their budget. It seems counterproductive to build to LEED certification standards and then on top of those costs, have to spend thousands of extra dollars on a certification that awards the school only a placard and bragging rights. This money can instead be used for further school greening attempts or even to buy books, playground equipment, musical instruments or other such necessities that schools rarely can afford.

Yet LEED can act as a starting place for a school to begin to understand the connection between architecture and the environment as well as to "learn from and work

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[93] "Building Design and Construction Fees." Accessed October 8, 2011 form http://www.gbci.org/main-nav/building-certification/fees/bdc.aspx
[94] Ibid.
[95] Ibid.
[96] Shendler, Auden and Udall, Randy. "LEED is Broken- Let's Fix It. "*iGreen Build: The Voice of Sustainable Design and Construction*. http://www.igreenbuild.com/cd_1706.aspx
[97] Ibid.

with the natural laws rather than against them when we design and build."[98] But, a school should not feel pressured to pursue a pricey certification. Green buildings are meant to enhance student learning and thus should not to be influenced by a need for publicity and recognition. The benefits for the students, teachers, community and environmental movement far outweigh the benefits of publicity for a not-for-profit school. Small greening strategies can be a great way to get a school started on the path to environmental literacy, instead of insisting unrealistically that the school must completely renovate in order to be sustainable.

One such way to promote green schools is simply to distribute the information concerning all of the benefits of green buildings to school districts, for these advantages have the power to be very persuasive to those wishing to increase productivity in their districts. This information could be used as a tool to pass bonds and generally gain more public funds for school greening projects. Another way to encourage schools to green their campuses is to publish lists of small ways to work towards a greener school, rather than insist, as LEED does, that the entire building must be sustainable in order to deserve recognition. If schools create plans along with students to carry out small tasks such as planting flowers in the schoolyard, or switching out traditional light bulbs for high efficiency ones, those too contribute to creating a sustainable school campus. Individual classrooms could be responsible for specific duties and all of the school's hard work could be recognized at an assembly or community gathering. Taking steps like these are just as important as huge renovation processes and offer an opportunity for kids to take an active role in greening their campus while feeling accomplished and proud of how they have

[98] Ford, Alan. *Designing the Sustainable School."* The Images Publishing Group: Victoria, Aus. (2007). Pg. 10.

helped their school and their community. Greening can be a whole school effort; it does not have to be restricted to school boards, principals, and the construction industry. Programs that encourage small-scale greening projects have been started on both state and federal levels, such as the Department of Education's Green Ribbon Schools Program.[99] This is a complete school greening plan that impacts much more than just buildings. This program shall be discussed at length below.

Green schools are clearly a good idea but without public knowledge of their educational, financial and health benefits it is very difficult for this movement to gain broad-based any support. If communities were aware of all of the advantages that green schools can provide, the choice to support sustainable school movements would be simple. Green schools make sense for all communities and are attainable. After examining the facts, it is quite difficult to deny that green schools are necessary if America wants its kids to spend their childhoods in safe buildings that allow them to effectively learn.

Sustainable Cafeterias

A school, however, is not just a place that students go each day to learn. Students usually spend at least seven hours in school each weekday and sometimes even more because of daycare or extracurricular activities. As such, a school must also fulfill the daily needs of a growing child. Food is obviously an integral part of a child's school experience. About half of all American public school students eat at least one meal a day at school (usually lunch) and many eat two or even three.[100] Lunch programs in schools could be

[99] http://www.ed.gov/blog/2011/05/green-ribbon-school-resources/
[100] Karliner, Joshua. "Thinking Big About Ecological Sustainability, Children's Environmental Health, and K-12 Education in the U.S." *Little Green Schoolhouse.* 2005. Pg. 26.

used as teaching tools to promote healthy and sustainable eating habits because a lunch line comprises a captive audience of children who will eat whatever looks appealing and tastes good. Kid's taste will then evolve as they learn to enjoy what the cafeteria has to offer. It would then seem logical that a cafeteria could double as a nutrition center, teaching kids to love fresh and local foods. However, this is rarely the case. By serving mainly processed, frozen, canned, and fried foods in schools, the public education system is failing to teach its students about the connection between their lives and land they inhabit. By learning where their food comes from, students are able to nurture a connection to the earth, for it keeps them alive and offers so many delicious treats. The soils and oceans of this country are fertile and bountiful, but it is difficult to appreciate this while consuming precooked fish sticks that, several generations ago, would not have been recognized as food, much less as fish. Additionally, cafeterias are vital in teaching kids eating habits that they will carry with them for the rest of their lives. Serving unhealthy food only increases the dietary crisis that America is currently facing. Schools have an the opportunity not only to improve the diet of the children they serve, but also to teach them about how the land supports their existence on earth. Kids learn habits as well as values from the foods they eat in school and it is therefore important that schools feed kids in such a way as to enforce sustainable eating habits.

Until recently, there was little state or federal legislation about what specifically should be served to children at school. When I was frequenting the lunch line in elementary school, I remember eating only pizza or chicken fingers and drinking flavored milk loaded with more sugar than a soda. There were usually no vegetables offered and the fruit was either red apples from a vending machine or 'fruit cocktails', which consisted of

lumps of indistinguishable fruits in a sugary syrup. Needless to say, the food was far from healthy or appetizing. As I got older, it only got worse; in middle and high school we could buy fast food at school. Pizza and teriyaki were the most popular and it was rare to see a student eating a vegetable of any kind in the cafeteria throughout my career in the public education system.

We were not alone. In 2005, 23.5% of high schools served fast food in their school cafeterias[101] and 58% of elementary schools sold soda or other beverages full of added sugars to children as young as 5 years old.[102] In addition, 12,000 public schools allow candy and junk food companies to advertise directly to children *on school grounds* in exchange for new technology systems for the school.[103] With all of these obstacles for children to overcome, is it really any surprise that between 16-33% of children in America are obese and that Type 2 diabetes is now considered an epidemic?[104]

The USDA has vague regulations about what students are supposed to be eating in school. According to information regarding the National School Lunch Program that serves 99% of public schools, "school lunches must meet the applicable recommendations of the Dietary Guidelines for Americans, which recommend that no more than 30 percent of an individual's calories come from fat, and less than 10 percent from saturated fat. Regulations also establish a standard for school lunches to provide one-third of the Recommended Dietary Allowances of protein, Vitamin A, Vitamin C, iron, calcium, and calories. School

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[101] "School Health and Program Study: Nutrition." *Journal Of School Health.* Vol 77 No 8. 2007. Pg. 2.
[102] Karliner, Joshua. "Thinking Big About Ecological Sustainability, Children's Environmental Health, and K-12 Education in the U.S." *Little Green Schoolhouse.* 2005. Pg. 26.
[103] Ibid. Pg. 27.
[104] "Obesity in Children and Teens." *American Academy of Child and Adolescent Psychiatry.* 2008. Retrieved July 21, 2011 from aacap.org/page.ww?name=Obesity+in+Children+and+Teens&section=Facts+for+Families

lunches must meet Federal nutrition requirements, but decisions about what specific foods to serve and how to prepare them are made by local school food authorities."[105] This is the extent of federal guidelines about what to feed kids at school. Given that the public school systems are almost always short of funds, it is no surprise that school lunchroom employees try to make the most of what they are given to work with. Frying pre-made, frozen food is often the quickest and cheapest way to make meals appetizing for kids and above all, most schools simply do not want to waste the food they have to serve.[106] They are forced to prepare it in a way that will make kids want to eat it to ensure continued funding for their lunch program. This is the reason that when in 2010 a Washington D.C. blogger spent a week in his daughter's elementary school kitchen, he found that they were serving strawberry milk and pop tarts (with 13 grams of sugar in half a package) for breakfast and allowing kids to opt out of eating the vegetables and fruits at lunch while only grabbing nachos, pizza, or "teriyaki beef bites." [107] In November 2011, Congress blocked proposed changes to the National School Lunch Program that would have eliminated pizza from the vegetable category of a lunch.[108] For children across the country, frozen pizza sauce may be the most significant "vegetable" they eat all day.

Schools should play a vital role in nurturing a child's eating habits and clearly they have been doing an abysmal job. The national average number of fruits and vegetables

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[105] "National School Lunch Program." Retrieved July 22, 2011 from http://www.fns.usda.gov/cnd/Lunch/AboutLunch/NSLPFactSheet.pdf
[106] Bruske, Ed. "Tales from a D.C. School Kitchen." *The Slow Cook*. 2010. Retrieved July 22, 2011 from http://www.theslowcook.com/2010/01/22/tales-from-a-d-c-school-kitchen-part-four/
[107] Ibid.
[108] Nixon, Ron. "Congress Blocks New Rules on School Lunches." *The New York Times.* (2011). Retrieved November 18, 2011 from http://www.nytimes.com/2011/11/16/us/politics/congress-blocks-new-rules-on-school-lunches.html?scp=1&sq=school%20lunche&st=cse

consumed by individuals of any age are far below the recommended amounts.[109] This is particularly true among children living in low income, urban environments.[110] Although there are multiple reasons why these children may be especially prone to poor eating habits, one important cause is that these metropolitan areas are often classified as food deserts: areas in which there are very few grocery stores that provide fresh produce.[111] In these areas, people tend to buy their food at small corner stores, which usually provide only packaged or frozen foods that are often full of sugar and fat.[112] Additionally, the few grocery stores in the area that may actually have fresh produce usually sell it for a high price that may be inaccessible to low-income families. Because the United States subsidizes products such as corn (which is then used in fast food chains and sugary beverages) rather than fresh fruits and vegetables, often only the middle and upper classes can afford to feed their children the healthy food that they need.[113] As a result, low-income families are traditionally burdened with more nutrition related health issues such as diabetes, hypertension and cardiovascular disease.[114] All of these diseases are preventable, but it is necessary to start healthy eating habits early in life. School is an obvious place to teach such habits and yet most schools are serving food similar to that found in the mini mart across the street.

To make food healthier and cheaper, schools should turn to sustainable eating practices to guide them. The main problem with the school lunch system is that many

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[109]Ratcliffe, Michelle; Merrigan, Kathleen; Rogers, Beatrice; Goldberg, Jeanne. "The Effects of School Garden Experiences on Middle School-Aged Students' Knowledge, Attitudes, and Behaviors Associated With Vegetable Consumption." *Society for Public Health Education.* Vol 12, No 1. (2011). Pg. 36.
[110] Ibid.
[111] Ibid.
[112] Ibid.
[113] Ibid.
[114] Ibid.

schools get their food premade and shipped to them, often from across the country. This system lends itself to unhealthy and unsustainable food because preservatives must be added in enormous quantities and the carbon footprint generated from trucking or shipping food across the country is large. Shipping precooked, frozen vegetables from hundreds of miles away does not make sense when some variety of fresh vegetable is most likely available within the state or even sometimes the district. It is obvious that food will look much less appetizing when it has spent the majority of its shelf life wrapped in plastic and piled into the back of a semi-truck, and this is preciously why cafeteria staff feel that they need to fry their foods or add additional sugar or fat to encourage kids to eat it, adding copious amounts of empty, artery-clogging calories.[115]

This can, however, be avoided. The best way to green a school cafeteria is to start a farm-to-school program. With farm-to-school programs, a school severs their relationship with cafeteria food corporations (usually slowly over time) and begins to contract with local farmers to get fruits, vegetables, dairy products and meats from farms in the area.[116] With these types of products, there is no need to fry, freeze or add preservatives to anything because it is all fresh and local. Kids are encouraged to try new things and their food both looks and tastes much better.[117] It was also noted in a study that when a school introduced a fresh salad bar to the cafeteria, the enrollment in the school lunch program increased.[118] Therefore, it is in a school's best interest to have fresh foods because students

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[115] Bruske, Ed. "Tales from a D.C. School Kitchen." *The Slow Cook*. 2010. Retrieved July 22, 2011 from http://www.theslowcook.com/2010/01/22/tales-from-a-d-c-school-kitchen-part-four/
[116] "National Farm to School Network: Nourishing Kids and Community." Retrieved October 9, 2011 from http://www.farmtoschool.org/aboutus.php
[117] Ibid.
[118] Graham, Heather; Feenstra, Gail; Evans, Anna; Zidenberg-Cherr, Sheri. "Davis School Program Supports Life-Long Healthy Eating Habits in Children." *California Agriculture.* Vol 58, No. 4. (2004).

will buy lunch instead of bringing it from home, thus increasing the school's funding.[119] The carbon footprint of the school will also dramatically decrease because the food will typically come from much closer and not necessitate nearly as much fossil fuel for transportation. It is clear that financially, programs that incorporate fresh, local foods benefit the school.

Farm-to-school programs have been so successful that they have grown in number nationwide from 400 in 2004 to more than 2,000 in 2010.[120] These programs now exist in all fifty states and in 2010 Congress allotted $40 million for grants to create farm-to-school programs as part of the Healthy, Hunger Free Kids Act.[121] Farm-to-school became a part of this Act because the program has extraordinary benefits for the children that it serves. First, good nutrition is obviously important but it is even more vital in a school setting. Students need to be able to concentrate in the classroom, but this is difficult when they have been eating mostly sugar all day. Many studies have shown that breakfast in particular is important for student concentration and if kids on breakfast programs at school are only being fed sugary toaster pastries and flavored milk, they are bound to be cranky or misbehave in class. Eating a large amount of sugar in one sitting causes blood sugar levels to rise and then fall rapidly.[122] This can cause mood swings that are not conducive to a classroom environment.[123] However, with more fresh fruits and vegetables

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[119] Graham, Heather; Feenstra, Gail; Evans, Anna; Zidenberg-Cherr, Sheri. "Davis School Program Supports Life-Long Healthy Eating Habits in Children." *California Agriculture.* Vol 58, No. 4. (2004).
[120] "National Farm to School Network History." 2010. Retrieved July 27, 2011 from http://www.farmtoschool.org/aboutus.php
[121] "National Farm to School Network Major Accomplishments." 2010. Retrieved July 27, 2011 from http://www.farmtoschool.org/files/publications_272.pdf
[122] Snyder Sachs, Jessica. "Sugar: Does it Really Make Kids Hyper?" *Parenting.* Pg. 2. *Retrieved July 26, 2011 from* http://www.parenting.com/article/sugar-does-it-make-kids-hyper?page=0,3
[123] Ibid.

available, kids will be more likely to eat them.[124] A study of the vegetable consumption of students fed from a local garden in which none of the vegetables were frozen, canned, or cooked but rather eaten fresh and almost directly out of the ground showed that students were more likely to eat a larger variety of vegetables and eat more vegetables per month than their counterparts who did not have access to fresh vegetables at school.[125] The same study also showed that students ate larger portions of vegetables *not* served at school, indicating that these students are eating more vegetables at home as well.[126]

This study is particularly pertinent to elementary school students because eating habits are formed early in life. Research shows that "originating in childhood and influenced by cultural background, eating habits remain resistant to change without long-term commitment."[127] Once a student gets to middle and high school, they may have their own money for lunch or will be responsible for bringing lunch to school and will have much more freedom to eat what they please.[128] If students are conditioned from a young age to eat carrot sticks and apple slices instead of pizza and candy, they will make better choices at school and even into adulthood. However, this also indicates that schools need to continue to have healthier, more sustainable options in middle and high schools so that all kids, but especially those on free or reduced lunch plans, will have the opportunity to eat in

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[124] Ratcliffe, Michelle; Merrigan, Kathleen; Rogers, Beatrice; Goldberg, Jeanne. "The Effects of School Garden Experiences on Middle School-Aged Students' Knowledge, Attitudes, and Behaviors Associated With Vegetable Consumption." *Society for Public Health Education.* Vol 12, No 1. (2011). Pg. 40.
[125] Ibid. Pg. 39.
[126] Ibid. Pg. 40.
[127] Fors, Stuart and Young, Elizabeth. "Factors Relating to the Eating Habits of Students in Grades 9-12." *Journal of School Health.* Vol 71, No. 10. (2009). Pg. 483.
[128] Ratcliffe, Michelle; Merrigan, Kathleen; Rogers, Beatrice; Goldberg, Jeanne. "The Effects of School Garden Experiences on Middle School-Aged Students' Knowledge, Attitudes, and Behaviors Associated With Vegetable Consumption." *Society for Public Health Education.* Vol 12, No 1. (2011). Pg. 41.

a healthy and environmentally sustainable way.[129]

By forming children's eating habits early in life in the place where they spend the majority of their waking hours, it may be possible to educate not only the kids but also their families and the community at large. The hope with farm-to-school programs is that even if students eat poorly at home, they will learn to like healthier foods at school and then request such foods at home. In this way, nutrition lessons at school affect not only the child but also his entire family, for these lessons can trickle down to parents who may begin to buy healthier food at their child's request.

Importantly, the food that kids eat also affects their perceptions of the earth. It is vital that students understand the ways in which they are connected to the natural world and that without these connections, life necessities that they take for granted, such as food from the grocery store, would not exist. From an environmental education standpoint, farm-to-school programs are very desirable because they often involve very close cooperation with local farmers and some programs even have field trips to farms or lessons from farmers. This gives children an opportunity to discover exactly where their food comes from and gives them a link to the community and to the earth. If kids see that their food comes out of the ground instead of simply off a grocery store shelf, they will feel more inclined to learn about and care for the earth because it directly impacts their lives. It also makes the community more heavily involved in the education of children and helps kids feel like a part of the world outside of their school.[130] These programs bring communities together because the public school, an institution around which much of the community revolves,

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[129] Fors, Stuart and Young, Elizabeth. "Factors Relating to the Eating Habits of Students in Grades 9-12." *Journal of School Health.* Vol 71, No. 10. (2009). Pg. 487.
[130] Hawkins, Donald; Vinton, Denis. *The Environmental Classroom.* Prentice-Hall, Inc.: Englewood Cliffs. (1973). Pg. 43.

ends up supporting local farms that may have been facing difficulty finding a sustainable and reliable market in which to sell their crops. Thus, farm-to-school not only makes the school itself more sustainable, but lends support to the community as well. The community surrounding a school "can become more than a collection of places from which students learn. It can be a cooperative learning environment involving give and take between school and community and the active participation of many segments of the community."[131] If students sees a farm and help a farmer harvest even a single carrot, this "give and take" mentality is established. This in turn helps the student see the real-world application of farming and taking care of the earth that provides for them because, "when education immediately becomes practical, it also becomes especially relevant to the learner."[132] This is also a useful tool because a teacher can only bring so much to the classroom environment.[133] Although teachers are an amazing resource, it is often helpful to integrate other speakers into the learning environment, such as farmers, because they will have had experiences that the teacher lacks.[134] In this way, students are not learning only the academic perspective of an issue but also the real life application. By seeing what happens at farms to bring delicious food to the lunch line, kids will be able to appreciate the impact of a sustainable lifestyle.

What kids learn in the classroom also carries over to their social lives outside of class. Teaching kids to eat foods that are healthy and environmentally sustainable is vital because

[131] Hawkins, Donald; Vinton, Denis. *The Environmental Classroom.* Prentice-Hall, Inc.: Englewood Cliffs. (1973). Pg. 43.
[132] Ibid. Pg. 47.
[133] Ibid. Pg. 80.
[134] Ibid.

kids represent a huge consumer group for the food industry.[135] A study showed that of employed high school students, 46% of girls and 41% of boys spent the majority of their earnings on food.[136] It is therefore critical to the environmental movement that these teens are aware of the environmental impacts behind their food choices. Kids who learn to eat healthy and local goods at school then desire them outside of class time.[137] It follows logically that students may be more likely to spend their money on products that reflect their tastes for local, fresh food, thereby supporting the community and the sustainable food movement.

There are no drawbacks to feeding kids healthier foods in school. These types of programs benefit kids, teachers, the community, the environment and even the taxpayers who, if current trends continue, will have to pay for the health care cost of a generation in which obesity is rampant. Getting healthy food into schools is a difficult process to begin because it involves a lot of community support and planning but it is well worth it. Sustainable cafeterias are an important part of environmental education because they create consistency within the school's policies. Even if teachers begin to integrate environmental education in the classroom, those lessons mean nothing if the school does not extend those ideas to the rest of the school, including the food served in the cafeteria. Teaching students that delicious healthy food can come directly from the earth without processing and adding artificial ingredients is a lesson that all kids should be learning. Healthy, sustainable food is the best kind of fuel for a young student's body and for a young

[135] Monoco Bissonette, Madeline; Contento, Isobel. "Adolescents Perspectives and Food Choice Behavior in Terms of the Environmental Impacts of Food Production Practices: Application of a Psychological Model." *Society for Nutritional Education.* (2001).
[136] Ibid.
[137] Ratcliffe, Michelle; Merrigan, Kathleen; Rogers, Beatrice; Goldberg, Jeanne. "The Effects of School Garden Experiences on Middle School-Aged Students' Knowledge, Attitudes, and Behaviors Associated With Vegetable Consumption." *Society for Public Health Education.* Vol 12, No 1. (2011). Pg. 40.

environmentalist's mind.

School Gardens

Even though green schools have grown in popularity in the past several decades, many students are still missing one of the most critical pieces of environmental education: learning *in* nature, instead of just *about* it. Humans mainly exist in the built landscape and although it is possible to learn from this setting (as with green schoolhouses) being indoors can also be a obstacle to the environmental education of children and teens. Despite programs such as "No Child Left Inside"[138] and the YMCA's "Get Movin'"[139] kids continue to spend much of their days inside; either in a classroom, daycare, or at their own homes. Even at recess, which should be a time for students to blow off steam in the outdoors and take a few breathes of fresh air, they are confined to a gated schoolyard and more often than not, spend all their time on concrete courts and playgrounds. Some schools in crowded cities even have their playgrounds on the roof of their buildings, enabling students to spend an entire day without their feet touching the actual ground. Recess time is also subject to cuts if schools fall behind state or national standards and are required to have more classroom instruction time.[140] That puts many students behind desks in classrooms for nearly 35 hours a week.

When the final bell rings, students travel home, often in a bus or personal car. Once at home, kids commonly to stay inside for much of the afternoon and evening. A study comparing the outdoor playing habits of kids ages 3-12 in 2004 versus their mothers play habits at the same age found that while 70% of mothers reported playing outside everyday

[138] http://www.cbf.org/page.aspx?pid=687
[139] http://www.get-movin.org/
[140] "Recess is "in Recess" as Schools Cut Child's Play." *Education Reporter.* No 189. (2001). Pg. 1.

in their youths, only 31% of their children followed this same example.[141] 25% of children in the study played outside only 2-3 times per week.[142] Instead of heading outside, many children instead spent the afternoons doing homework, watching television, playing video games or checking social media accounts.[143] There is no denying it: modern children are suffering from "nature deficit disorder."[144]

This is bad news for the environmental movement, for it is clear that experiencing nature is one of the best ways to increase environmental literacy.[145] In a study that attempted to measure university students' concern for the environment, a variety of different influences were considered, including parents, friends, teachers, outdoors experience, organizations, media, religion and others.[146] When students were asked to rate how each of the categories affected their positive view of the environment and their desire to preserve it, the category of outdoor experience won by a landslide.[147] This category proved to be even more important than teachers' or parents' impacts.[148] This study has huge implications, for schools represent a space in which these positive influences can be cultivated. The authors of this study wrote: "if the data achieve nothing but a little persuasion of those who are responsible for budgets for field centres and environmental programmes to the effect that outdoor activities are essential at all levels of schooling, then

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[141] Clements, Rhonda. "An Investigation of the Status of Outdoor Play." *Contemporary Issues in Early Childhood.* Vol. 5, No 1. (2004). Pg. 73.
[142] Ibid.
[143] Ibid. Pg. 74.
[144] Cutter-Mackenzie, Amy. "Multicultural School Gardens: Creating Engaging Garden Spaces in Learning About Language, Culture and Environment." *Canadian Journal of Environmental Education.* Vol 14. (2009). Pg. 123.
[145] Palmer, Joy; Neal, Philip. *The Handbook of Environmental Education.* New York: Routledge Press. (1994). Pg. 8.
[146] Ibid.
[147] Ibid. Pg. 9.
[148] Ibid.

the project will have achieved a tremendous amount for the planet."[149] Students may not always have access to natural spaces such as city parks or nature preserves, particularly those students living in urban areas. Students who live in apartment buildings may not even have access to an outdoor space in which to play on a daily basis. However, schools do have the potential to provide this important type of space for their students. Although many schoolyards are also encased in concrete, it is possible to create green spaces within them, no matter how small. Gardens in a schoolyard can provide the bridge between an inner city school and the natural world outside the mass of buildings, roads, and sidewalks.

School gardening is not a new phenomenon, although the rational for creating green spaces on campuses have drastically changed over time. The first school gardening movement began in 1918 when the United States entered World War I. The Federal Bureau of Education passed specific legislation stating that, "Every boy and every girl … should be a producer. The growing of plants … should therefore become an integral part of the school program."[150] For the duration of the war, schools were given funding to create produce-growing gardens that were completely cared for by children. These 'victory gardens' were usually in urban and suburban schools because rural areas were already almost exclusively dedicated to this cause.[151] This legislation had two main goals. Food production in a time of war was of course the most important, but the federal government was also trying to instill a 'pride of product' mentality in its youth in order to hopefully

[149] Palmer, Joy; Neal, Philip. *The Handbook of Environmental Education.* New York: Routledge Press. (1994). Pg. 9.
[150] Hayden-Smith, Rose. "Soldiers of the Soil: The Work of the United States School Garden Army During World War I." *Applied Environmental Education and Communication.* Vol 6. (2007). Pg. 1.
[151] Ibid.

grow the future economy of the country.[152] This legislation was groundbreaking at the time because not only did it get 2 million children involved in the war effort, but also was one of the first times in which the country mandated a federal curriculum requirement.[153]

This same program was also important during World War II and had similarly productive outcomes.[154] However, as the war drew to a close and the suburban lifestyle of the 1950s consumed the country, school gardens began to dry up or were replaced with new classrooms to accommodate the enormous influx of Baby Boomers in the nation's schools.[155] The movement was reclaimed in the 1990s as the country began to take note of environmental degradation and gardens are now especially prevalent in states such as California and Texas.[156] In the later part of the 1990s, California passed the "Garden in Every School" Initiative, which called for a statewide gardening program to combat rising health concerns such as Type 2 diabetes and disinterest in environmental preservation.[157] By 2002, more than 2,000 schools had met the requirements of this initiative.[158]

School gardens can take many forms. Depending on the location and the funds that the school has to allocate to a garden program, the spaces vary from a few potted vegetables to extensive raised beds, green houses, and butterfly gardens.[159] The most complex school gardens involve composting system, worm bins, outdoor classrooms and

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[152] Hayden-Smith, Rose. "Soldiers of the Soil: The Work of the United States School Garden Army During World War I." *Applied Environmental Education and Communication.* Vol 6. (2007). Pg. 1.
[153] Ibid.
[154] Ibid.
[155] Ibid.
[156] Blair, Dorothy. "A Child in the Garden: An Evaluative Review of the Benefits of School Gardening." *The Journal of Environmental Education.* Vol. 4, No 2. (2009). Pg. 1.
[157] Ozer, Emily. "The Effects of Schools Gardens on Students and Schools: Conceptualizations and Considerations for Maximizing Healthy Development." *Journal of Health Education and Behavior*. (2006). Pg. 1.
[158] Ibid.
[159] Ibid. Pg. 2.

ponds.[160] Most commonly, school gardens are built in a section of an already developed schoolyard. Raised beds can be created right on top of already laid asphalt, or areas of grass that are rarely used can be torn up and sectioned off to create a garden. The trend in the United States is for the majority of school gardens to be built in elementary schools.[161] As a general rule, primary schools tend to have more space to accommodate gardens because they do not need to have large sports fields, parking structures, and stadiums. They also usually already have an established outdoor area for children because of recess requirements. This area is often the best place to build a garden because it will be accessible to all students and teachers and is easy to keep an eye on to avoid vandalism or general abuse.

Starting and maintaining a school garden is no small task; it takes an enormous amount of time, effort and commitment. The first step in creating a successful garden program is planning. It is important to get a wide range of people involved in the implementation of the program.[162] The staff of a school usually has difficulty successfully running a garden program by themselves because they already have an enormous caseload of students and many duties outside of simple classroom instruction such as meetings, recess or lunch duty and tutoring. Principals too do not always have time to set apart from their administrative and disciplining tasks to work outside in a garden. In a study of public school gardens in California elementary schools, researchers found that principals named

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[160] Ozer, Emily. "The Effects of Schools Gardens on Students and Schools: Conceptualizations and Considerations for Maximizing Healthy Development." *Journal of Health Education and Behavior*. (2006). Pg. 2.

[161] Blair, Dorothy. "A Child in the Garden: An Evaluative Review of the Benefits of School Gardening." *The Journal of Environmental Education.* Vol. 4, No 2. (2009). Pg. 2.

[162] Graham, Heather; Lane Beall, Deborah; Lussier, Mary; McLaughlin, Peggy; Zidenberg-Cherr, Sheri. "Use of School Gardens in Academic Instruction." *Society for Nutrition Education.* (2005). "Use of School Gardens in Academic Instruction." *Society for Nutrition Education.* (2005). Pg. 3.

parents, teachers, community members and garden coordinators as the most important contributors to a successful gardening program.[163] Not surprisingly, 57% of principals of schools without gardens said that the main reason they did not have a garden program was time constraints.[164] Because many public school systems have not yet generally recognized the importance of garden based education, there are very few schools with staff members whose specific job it is to create and maintain gardens.[165] For this reason, it is important to gain the support of parents, community members and even non-profit organizations early on in the process. A stellar example of community and non-profit organization support for school gardens is the Edible Schoolyard (ESY) Project in Berkeley, California.[166] This program involves gardening and cooking classes for middle school students with the goal of creating healthy, sustainable eating habits in public schools.[167] The ESY in Berkeley has grown into an acre of learning gardens and has created satellite programs across the country.[168] Non-profit and community support, like that seen at the ESY, can bring in funds and volunteers who will supply enough adult supervision to get a garden started.[169]

Teachers however, will play a very central role in the use of the garden; therefore teacher training is vitally important. A survey of California school gardens showed that 74% of schools that managed to build and maintain gardens were unable to effectively use

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[163] Graham, Heather; Lane Beall, Deborah; Lussier, Mary; McLaughlin, Peggy; Zidenberg-Cherr, Sheri. "Use of School Gardens in Academic Instruction." *Society for Nutrition Education.* (2005). "Use of School Gardens in Academic Instruction." *Society for Nutrition Education.* (2005). Pg. 3.
[164] Ibid.
[165] Ibid.
[166] http://edibleschoolyard.org/berkeley/about-us
[167] Ozer, Emily. "The Effects of Schools Gardens on Students and Schools: Conceptualizations and Considerations for Maximizing Healthy Development." *Journal of Health Education and Behavior*. (2006). Pg. 848.
[168] http://edibleschoolyard.org/berkeley/about-us
[169] Ibid.

them for student learning because of lack of teacher interest, knowledge and training.[170] Thus, before the garden can be a useful tool, it is important to teach the teachers how to use it in the best way possible. One effective technique for this training is to hire master gardeners to help teachers to learn gardening basics; from there teachers will be able to use the skills gained in their educational degree to determine the best ways to relay this information back to their classes.[171] The fact remains that teachers know how to relate to students, but if they do not understand the material themselves or simply do not feel comfortable in the space, the garden will not be used to its full potential.

However, if used enthusiastically, gardens can have academic benefits; in fact, 89% of principles in schools with gardens reported that academics were the primary reason they had decided to implement a gardening program.[172] Although environmental science is the most obvious and likely subject to be taught in the garden, California teachers reported using their classroom gardens to teach math, nutrition and language arts.[173] Teaching such subjects in the natural world rather than just on a classroom blackboard can have many benefits for student progress. A study that compared the success of students taught in a traditional setting versus those who were taught through the lens of environmentalism

[170] Graham, Heather; Lane Beall, Deborah; Lussier, Mary; McLaughlin, Peggy; Zidenberg-Cherr, Sheri. "Use of School Gardens in Academic Instruction." *Society for Nutrition Education.* (2005). Pg. 149
[171] Blair, Dorothy. "A Child in the Garden: An Evaluative Review of the Benefits of School Gardening." *The Journal of Environmental Education.* Vol. 4, No 2. (2009). Pg. 35.
[172] Ozer, Emily. "The Effects of Schools Gardens on Students and Schools: Conceptualizations and Considerations for Maximizing Healthy Development." *Journal of Health Education and Behavior*. (2006). Pg. 848.
[173] Ibid.

found that students in an environmental education setting received higher grades and scored better on standardized tests for reading, writing and math.[174]

The most accepted explanation for this success is that students are more likely to listen and retain information that pertains to something in their lives to which they can relate.[175] For example, teaching math principles with real-life examples makes students more likely to remember the ideas behind solving the problem and also encourages them to use these principles in their everyday lives to solve real problems. If, for instance, a teacher taught multiplication while planting rows and columns of seeds in the garden, a child would be more likely to want to participate and more likely to remember the lesson because the memory of seed planting is so much more exciting than using counting blocks or completing a worksheet. The same would be true of a lesson in which older students were instructed to compare the writings of an environmentalist author, like Rachel Carson or Walt Whitman while sitting in the garden. A teacher could prompt with interactive questions such as, "What do you see in our school garden that is similar to the world the author describes?" or by creating an assignment in which students write their own observations of their garden. By allowing students to frame their schoolwork around something that they are familiar with and can take pride in, they will be more likely to be enthusiastic about learning and the teacher will be able to incorporate environmental lessons into the school day as well.

Environmental learning is perhaps one of the most important results of school gardening, especially today when 83% of the United States population lives in urban

[174] Lieberman, Gerald and Hoody, Linda. "Closing the Achievement Gap: Using the Environment as an Integrating Context for Learning." *State Education and Environment Roundtable.* 1998. Pg. 5.
[175]Ibid. Pg. 7.

areas.[176] Kids in metropolitan centers often do not have the opportunity to interact with nature on a daily basis and thus could begin to feel disconnected from the natural world. However, being allowed to spend time in a garden and actively seek out soil, worms and sunshine, students will begin to appreciate the world around them again. Robert Pyle, an expert on butterflies, likes to teach children about his favorite insects by placing one of each of the young children's noses.[177] The kids revel in the experience but he notes, "somewhere beyond delight lies enlightenment. I've been astonished at the small epiphanies I see in the eyes of a child in truly close contact with nature."[178] Even this small act of being a part of nature is a way in which to learn. Richard Louv wrote that "discovering- or rediscovering- nature through the senses is simply a way to learn, to pay attention"[179] and thus when kids are given the opportunity to spend more time outside, they will inevitably come to love nature and thus want to protect it. Students at school gardens that the Earth Day Network has created were often from the inner city and did not spend very much, if any, time in nature. However, after being given the opportunity to dig in the soil with their own hands and harvest the vegetables that they had planted, students were enthusiastic about going outdoors and even begged to be allowed to spend time in the school garden. A study done in Florida elementary schools found that no matter what type of garden a school had (large, small, vegetable, flower, etc.) the students surveyed had a particularly high sense of responsibility towards nature and more positive environmental

[176] Blair, Dorothy. "A Child in the Garden: An Evaluative Review of the Benefits of School Gardening." *The Journal of Environmental Education.* Vol. 4, No 2. (2009). Pg. 17.
[177] Louv, Richard. *Last Child in the Woods.* Algonquin Books: Chapel Hill. (2005). Pg. 76.
[178] Ibid.
[179] Ibid. Pg. 78.

attitudes.[180] Having a sense of accomplishment and ownership over something like a class garden makes students proud and gives them to desire to take care of it. The same will then translate to the earth at large because, "a garden is an environment in miniature, and to be successful a gardener must work in sympathy with nature."[181] This creates what some refer to as a nature-culture continuum: the idea that nature is local and thus an important aspect of culture.[182] A study confirmed this view when it found that "adults who had significant and positive exposure to nature as children—experiences, often with significant adults, that socialize them to view nature in positive and meaningful ways—were more likely to be environmentally sensitive, concerned, and active."[183] The same principle applies with all types of environmental education; if students appreciate the earth and understand the ways in which nearly every part of their daily lives somehow is related to the planet, they will want to both spend time in nature and take care of it.[184]

School gardens however, do not just impact the children who work and play in them: there is also a trickle down effect that has the potential to impact parents, friends, and the entire community at large. Teachers in California schools overwhelmingly observed that students at their schools came to describe the garden not as "a garden" but rather as "our garden."[185] Students would come to school early just to be able to spend

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[180] Bradley, Jennifer and Skelly, Sonja. "The Growing Phenomenon of School Gardens: Measuring Their Variation and Their Affect on Students' Sense of Responsibility and Attitudes Towards Science and the Environment." *Applied Environmental Education and Communication.* (2007). Pg. 102.
[181] Ibid.
[182] Ibid.
[183] Ibid. Pg. 18.
[184] Blair, Dorothy. "A Child in the Garden: An Evaluative Review of the Benefits of School Gardening." *The Journal of Environmental Education.* Vol. 4, No 2. (2009). Pg. 17.
[185] Ozer, Emily. "The Effects of Schools Gardens on Students and Schools: Conceptualizations and Considerations for Maximizing Healthy Development." *Journal of Health Education and Behavior*. (2006). Pg. 854.

time in the garden and observe new changes.[186] This shows that space bonding is an outcome of school gardening. Not only will students feel more at home in their own garden because they feel a sense of pride in it, but they will also inevitably build friendships with others that spend their time there as well. A study of community gardens in New York found that when people worked cooperatively together in the space, it "helped to foster pride in the neighborhood, evidence of which could be seen in reduced littering rates and improved maintenance of other properties in the neighborhood."[187] A sense of community like this will benefit the school at large in an aesthetic fashion, for with a sense of belonging comes a sense of responsibility.

Gardens can also foster a sense of connectedness for students who may be slipping through the cracks of the public school system. A study found that "adolescents who report feeling more connected to school show lower levels of emotional distress, risk behavior, and aggression… Interventions that increase children's bonding to school have shown long-term results of lower substance use, delinquency, violence, academic problems, and sexual activity in adolescence and young adulthood."[188] Gardens will not only foster environmental awareness but will also add to the general happiness, success and mental health of the students involved in them.

Gardens are perhaps one of the simplest ways to green a school and create a sense of community and environmental responsibility. A simple garden takes very little money to

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[186]Ozer, Emily. "The Effects of Schools Gardens on Students and Schools: Conceptualizations and Considerations for Maximizing Healthy Development." *Journal of Health Education and Behavior*. (2006). Pg. 854.
[187] Assadourian, Erik. "The Growing Value of Gardens." *World Watch.* (2003). Pg. 42.
[188] Ozer, Emily. "The Effects of Schools Gardens on Students and Schools: Conceptualizations and Considerations for Maximizing Healthy Development." *Journal of Health Education and Behavior*. (2006). Pg. 854.

create and although it requires many committed individuals, it has been shown to be a worthwhile commitment for schools, especially for the purpose of increasing environmental literacy. This is perhaps best shown in a lengthy study of children who were taught in an integrated garden-learning program. With the help of gardens, "children's relationship with the environment changed and became more personal…the majority of children shifted from seeing the environment as an object or a place, to a view characterized by the interconnectedness of humans and environment."[189] The benefits of gardening are diverse and in the long run will benefit the school, the community, the students, and the natural environment.

Environmental Education Curriculum

All the ways outlined thus far in which to create a more environmentally literate community have required some money to underwrite the construction of a new school building or the development of a new program. Although green buildings will pay for themselves over time, a large sum of money is required to even begin to draw up plans for a new or improved facility. Renovating a school lunch program also requires funding and even school gardens, although the cheapest option, still require the purchase of seeds, tools and soil. However, the method that is simplest and cheapest but still least likely to be taken seriously, is instituting environmental education curriculum at all grade levels. This is possible to do even with no extra budget, no spare teachers, and no extra class periods in the school day. This is the component of teaching environmental literacy that has the

[189] Cutter-Mackenzie, Amy. "Multicultural School Gardens: Creating Engaging Garden Spaces in Learning About Language, Culture and Environment." *Canadian Journal of Environmental Education.* Vol 14. (2009). Pg. 124.

ability to tie all of the other elements such as green buildings, sustainable food and school gardens together to create aware and environmentally active young citizens.

Until fairly recently, the idea of environmental education as a necessary part of schooling had been dismissed, even by some scholars and educational theorists. Howard Gardner, a Harvard University professor, coined his "seven intelligences" theory in 1983 but this theory did not include any type of learner who worked best in the outdoors.[190] Instead, his original seven intelligences included linguistic, logical-mathematical, spatial, kinesthetic, musical, interpersonal and intrapersonal intelligences.[191] At the time, the idea that a child could be more than "book smart" and that perhaps education should take a more interdisciplinary approach instead of assuming that all children learn in a similar fashion was revolutionary.[192] In 1995, Gardner updated this famous list to include naturalist intelligence, such as that displayed by Charles Darwin, John Muir, and Rachel Carson.[193] Gardner writes: "My recognition that such individuals could not readily be classified in terms of the seven antecedent intelligences led me to consider this additional form of intelligence and to construe the scope of the naturalist's abilities more broadly."[194] Students who are strongest in this type of intelligence have well-developed sensory skills that they use to learn from the world around them and are also more likely to easily observe patterns across a range of subjects.[195] Gardner found naturalistic learning to be of

[190] Louv, Richard. *Last Child in the Woods.* Algonquin Books: Chapel Hill. (2005). Pg. 71.
[191] Ibid.
[192] Ibid.
[193] Ibid.
[194] Gardner, Howard. I*ntelligence Reframed: Multiple Intelligences for the 21st Century.* Basic Books: New York. (1999). Pg. 48.
[195] Louv, Richard. *Last Child in the Woods.* Algonquin Books: Chapel Hill. (2005). Pg. 72.

such monumental importance that it merited a revision to his well-accepted work.[196] This was a great step ahead for environmental education, for it emphasized the need for learning to take place both inside and outside of the classroom and to use nature, in the form of outdoor spaces and environmental principles and examples, as a teaching tool for all subjects. Gardner's original writings on multiple intelligences changed the way that many educators viewed learning, so why has his new evidence for naturalistic intelligence which, in his words "clearly merits addition to the list of the original seven intelligences"[197] not done the same?

The main obstacle to integrating environmental education into the school system is the way in which the United States has defined and created systems of learning. David Orr, a scholar and professor of environmental studies has argued: "We have fragmented the world into bits and pieces called disciplines and sub disciplines, hermetically sealed from other such disciplines. As a result, after 12 or 16 or 20 years of education, most students graduate without any broad, integrated sense of the unity of things."[198] For this reason, teachers and schools are usually hesitant to begin to incorporate environmental education into their curriculum because it would appear that integrating a whole new subject into an already packed schedule is impossible when standards must be met and test scores must always be on the rise. If environmental education is added, what must be sacrificed: math, reading or music? This however, should not be an issue at all because environmental education is best suited to be embedded into other subjects for it can be used as a

[196] Gardner, Howard. I*ntelligence Reframed: Multiple Intelligences for the 21st Century.* Basic Books: New York. (1999). Pg. 52.
[197] Ibid.
[198] Orr, David. *Earth in Mind: On Education, Environment, and the Human Prospect.* Island Press: New York. (1994). Pg. 11.

framework around which to teach basic learning. Environmental education seeks to tie all of these subjects together and to create a student who is more holistically prepared to tackle real world problems, while still meeting state standards in reading, writing, and math.

It is also vital to understand that not all environmental education has to be, or even should be, science based. Even scientists themselves are able to see beyond their own discipline to appreciate that there is more to learning than just memorizing facts. Environmental education for young children can be as simple as letting a child discover nature in any way that they can, whether through textbooks or exploration. There is no doubt that science is important as a framework in which to understand the natural world and thus be able to analyze environmental issues in other disciplines. However, it is clear that simply knowing the chemical formula for ozone will do nothing in and of itself to repair the hole in the ozone layer. Currently, the real place in which the environment is being neglected is in all disciplines other than strictly environmental science and in the act of bringing them together for complete global significance. Because "the ultimate aim of environmental education is to sustain our planet and its resources for future generations, then a related aim must be to provide an education which encourages people to strive towards that goal,"[199] and we must move away from the idea that only scientists can make this happen. Instead, schools should encourage the idea that no matter what a student's interest is, it can be viewed through the lens of the natural world.

[199] Palmer, Joy; Neal, Philip. *The Handbook of Environmental Education.* New York: Routledge Press. (1994). Pg. 5.

This is the goal of all work done at the Earth Day Network. The lesson plans that are available on its website cover every academic discipline imaginable but science was not the main focus; indeed while working at the Earth Day Network, I wrote a variety of lesson plans and not one of them was labeled as a science lesson. Social studies is perhaps as important in environmental education because environmental problems have always influenced social and political issues across the world, such as the need for clean water or energy. Environmental issues can also be used effectively to help students understand the process of government such as in a lesson plan I wrote in which students took on the roles of different actors in the national debate over using corn for ethanol fuel vs. using it to feed the hungry. Although there was a small amount of science involved so that students would have a basic understanding of how corn becomes ethanol, the majority of the lesson was learning about how the political system works and recognizing that there is no one correct answer to many environmental problems. At the end of this lesson, students are assigned to write a letter to their member of Congress to state their personal opinion on this debate. In this manner, students will learn about an environmental issue as well as become active members of the political community. This lesson plan will be discussed in more detail later.

Other lesson plans asked elementary school students to forage for interesting leaves, bark, or sticks in the playground and then make a work of art with what they collected. Others encourage high school students to analyze the environmental messages in poems by Walt Whitman or estimate how much money it costs and how much fossil fuel emissions are produced when shipping a pair of jeans made in Taiwan to a store in Los Angeles. Environmental education can be art, literature, history, economics, physical

education, health and more. This is perhaps one of the most interdisciplinary subjects in K-12 education and yet is still one of the least likely to be taught.[200]

The benefits of incorporating environmental education into a classroom are many and varied. Student learning of all subjects can be enhanced if taught with the natural world in mind.[201] A study that compared the success of students who were being taught in a traditional setting versus those who were taught from an ecological perspective found that students in an environmental education setting received higher grades and scored better on standardized tests for reading, writing and math.[202] The most accepted explanation for this success is that students are more likely to listen and retain information that pertains to something in their own lives to which they can relate.[203] For example, teaching math principles with real life examples, like how many carrots are harvested from the class garden or what percentage of the school's energy comes from sustainable sources, makes students more likely to remember the ideas behind solving the problem and also encourages them to use these principles in their everyday lives to solve other real problems. This approach provides something of a double benefit, for not only does it improve student scores and understanding, but also teaches them environmental lessons at the same time.

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[200] "Why Teach Environmental Education?" *Classroom Earth: A National Environmental Education Foundation Program.* 2008. Retrieved July 28, 2011 from http://www.classroomearth.org/node/251

[201] Lieberman, Gerald and Hoody, Linda. "Closing the Achievement Gap: Using the Environment as an Integrating Context for Learning." *State Education and Environment Roundtable.* 1998. Pg. 5.

[202] Ibid.

[203] Ibid. Pg. 7.

Sadly, this is not a wide spread technique for supplementing student learning; as of 2010 only 20% of teachers incorporated environmental education into their classrooms.[204] It may be for this very reason that the world is currently embroiled in an environmental crisis; many generations have grown up not understanding or caring about the earth but rather staying inside and turning their attentions to other pursuits.[205] Kids need to get outside and get environmentally educated so that they can begin to care about the world around them. Otherwise, we are in great danger of creating an apathetic generation that will do nothing to curb the unsustainable practices of our society that are creating a worldwide environmental disaster.[206]

Admittedly, it would be quite difficult to completely overhaul an entire curricular system in a quick and seamless manner. However, there are small ways to begin to incorporate environmental learning into schools across the country. One such plan comes from a science teacher in Paso Robles, California. He was able to convince all of his fellow teachers at the high-school level to participate in "Sustainability Week." During this time, all normal classes were cancelled and students rotated between classrooms in which teachers from every discipline taught environmentally themed lessons.[207] These covered a variety of topics including population growth, women's rights, globalized trade and more.[208] This was a great lesson for teachers because it showed that environmental

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[204] "Why Teach Environmental Education?" *Classroom Earth: A National Environmental Education Foundation Program.* 2008. Retrieved July 28, 2011 from http://www.classroomearth.org/node/251
[205] Clements, Rhonda. "An Investigation of the Status of Outdoor Play." *Contemporary Issues in Early Childhood.* Vol. 5, No 1. (2004). Pg. 73.
[206] Blair, Dorthy. "A Child in the Garden: An Evaluative Review of the Benefits of School Gardening." *Journal of Environmental Education.* 2009.
[207] DiMaggio, Mark. "Educating for Sustainability in American High Schools." *Education for a Sustainable Future: a Paradigm for Hope in the 21st Century."* New York: Kluwer Academic/Plenum Publishers. (2000). Pg. 80.
[208] Ibid.

education can be incorporated into just about every subject and that whatever their training, they do have the tools and knowledge to make environmental learning a part of their curriculum. It was also beneficial and new for the students. The author reports that the most common reaction from students was, "why hasn't anyone taught us this before?" [209] Richard Louv confirmed this attitude when he argued: "perhaps the eighth intelligence is the intelligence within nature, the lessons waiting to be delivered if anyone shows up."[210] This was true for these high school students because when they were presented with environmental curriculum, they were more than happy to listen and learn all that they could.[211]

Incorporating environmental education into public schools seems like an obvious choice for legislators, but this turns out not to be the case. The Environmental Protection Agency (EPA) has budgeted only 8 million dollars to promote environmental education,[212] which works out to less than 15 cents per student. This is a pittance, but environmental education could still be pioneered if the spark of necessity was planted within public schools. There are a variety of free lesson plans online, grants to buy environmentally themed school supplies and even organizations that will volunteer to teach environmental literacy classes at schools. Teaching environmental education is possible and even plausible. The public school system was created to give every child an equal chance at

[209] DiMaggio, Mark. "Educating for Sustainability in American High Schools." *Education for a Sustainable Future: a Paradigm for Hope in the 21st Century."* New York: Kluwer Academic/Plenum Publishers. (2000). Pg. 78.
[210] Louv, Richard. *Last Child in the Woods.* Algonquin Books: Chapel Hill. (2005). Pg. 77.
[211] DiMaggio, Mark. "Educating for Sustainability in American High Schools." *Education for a Sustainable Future: a Paradigm for Hope in the 21st Century."* New York: Kluwer Academic/Plenum Publishers. (2000). Pg. 78.
[212] Karliner, Joshua. "Thinking Big About Ecological Sustainability, Children's Environmental Health, and K-12 Education in the U.S." *Little Green Schoolhouse.* 2005. Pg. 30.

having a successful adult life, but this will be impossible if we ignore the environmental intelligence.

What is an Environmental Lesson Plan?

To teach for environmental literacy, it is important to understand the components of an environmental education lesson. Although not all lessons will have exactly the same format, there is a model that can be used to build environmental lessons that will allow students to learn the knowledge necessary to think critically about environmental issues. Similar to the way in which environmental literacy has five distinct parts--awareness, knowledge, attitude, skills and action-- a model for teaching environmental education has similar elements. To make these lessons simpler for teachers to teach and to assess their students within the goals of environmental literacy, it is helpful to merge the first three aspects-- awareness, knowledge and attitude-- into one category. These three aspects of environmental literacy are often addressed in the same part of a lesson plan as they involve the background knowledge that is needed to carry out learning activities. Joy Palmer and Philip Neal, authors of the comprehensive *Handbook of Environmental Education*, use the term *concern* to refer to these elements; a lesson must create a student's concern for the subject, so that not just information is imparted but the student also has a firm understanding of the ways in which the subject they are studying impacts other aspects of their lives or the lives of others.[213] Next is *skills:* a student will learn effectively from having a personal experience with the topic in whatever manner is plausible for the school and lesson plan.[214] Lastly, a student must be prompted to take *action* on behalf of the

[213] Palmer, Joy; Neal, Philip. *The Handbook of Environmental Education.* New York: Routledge Press. (1994). Pg. 38.
[214] Ibid.

information they had acquired and their own personal opinions that they have developed with this newfound knowledge.[215] When creating or reviewing curriculum for environmental education programs, it is crucial to use this framework.

To demonstrate the effectiveness of this lesson planning strategy, I will assess a lesson plan I wrote for the Earth Day Network in June 2011. This plan is a good example of the techniques that can be used to teach lessons of an environmental nature as well as those that cover a variety of related disciplines. Because the essence of this lesson plan is an ethical debate with no "correct" answer, it is important for the teacher to present the facts and the many sides of the argument, but allow students to draw their own conclusions before they complete the final assignment. This is one of the most basic necessities of an environmental lesson plan, because teaching for environmental literacy "involves children in thinking for themselves, in personalized and meaningful learning, and in expressing facts and ideas in an original and interesting way, without regard for subject barriers and formalized, rigid 'right or wrong' answers."[216] By looking at the different parts that are necessary for an effective environmental lesson plan and analyzing how they relate to the concept of environmental literacy as well as other subjects, one can better appreciate just how comprehensive environmental education is and the most effective ways to teach it. The lesson plan in its original version can be found in the appendix; only the key elements for this examination are presented here.

CORN: FOOD OR FUEL?

[215] Palmer, Joy; Neal, Philip. *The Handbook of Environmental Education.* New York: Routledge Press. (1994). Pg. 38.
[216] Ibid. Pg. 53.

INTRODUCTION

As increasing evidence points to the fact that the world's addiction to fossil fuels actually creates more problems than it solves, scientists all over the globe race to find new, sustainable fuel sources. Many ideas have been suggested, such as wind, solar or hydropower and each has varying levels of support, protest, financial and political backing, research and exposure. Perhaps one of the better-known fuel types, largely because it has sparked a very heated debate, is ethanol: a liquid fuel made from plant matter. Although ethanol can be made from a number of different plants, in the U.S. it is most commonly derived from corn. This source of fuel has created a global conversation about the ethics of using food as fuel when parts of the world are still starved for both. In this lesson, students will learn how ethanol is made and delve deep into an examination of the pros and cons of its use. They will also participate in an academic debate and learn to speak persuasively to their peers. Finally, students will synthesize many different arguments to make a decision regarding their own stance on this important, yet highly volatile, debate.

The introduction lays out exactly what the students will be learning so that the teacher can decide if this lesson is right for the class before teaching it. This also gives teachers the ability to share lesson plans with their colleagues. Sharing lesson plans is a wonderful way for teachers to spread creative ideas and knowledge to their peers who may be unaccustomed to teaching environmental education. In the case of this lesson plan, which was written for a non-profit organization and available to teachers across the country, explicit clarity about every detail was crucial so that there would be no confusion and the plan could be taught in a range of classrooms that may vary in number of students, amount of time and access to supplies. Additionally, the introduction exemplifies the ways in which environmental concepts will be highlighted in the lesson, so that the teacher knows if this lesson fits within the goals of the class, the student's academic level and relevant state requirements.

LESSON OVERVIEW

Grade Level & Subject: *Grades 9-12: Civics*

Length: *2 – 3 class periods*

Objectives:
After completing this lesson, students will be able to:
- *Explain how ethanol is produced*
- *Describe the pros and cons of using corn as a fuel source*
- *Explain the attitudes of various groups involved in the corn as food vs. corn as fuel debate and where the student personally stands on this issue*

The goals of this lesson are multidisciplinary. Although the lesson is labeled as civics, it could also be considered science, social studies, history, current issues, and public speaking, for it combines all of these elements through an environmental and analytical framework. Objectives should be listed at the beginning of the lesson, for as Palmer and Neal acknowledge, "a useful staring point for planning could be to list the key concepts that will be addressed throughout the topic in order for the children's knowledge and understanding to be developed."[217] The three objectives effectively layout the ways in which the teacher will incorporate *concern* (what ethanol is and why there is a debate), *experience* (discovering and defending the pros and cons of its use) and *action* (where the student stands on the issue and how they will act upon this opinion).

Materials Needed:
- *Stopwatch*
- ***Reproducible #1 – Where is Corn Hiding?***
- ***Reproducible #2 – Food vs. Fuel Debate Roles***
- ***Reproducible #3 – Corn: Food or Fuel Debate Rubric***

Assessment:
Students will be assessed through the following activities:
- *Participation in class warm up and wrap up discussions*
- *Participation in the class debate*
- *Completion (and presentation if applicable) of letter to Member of Congress*
- *Completion of* ***Reproducible #3 – Food vs. Fuel Debate Rubric***

[217] Palmer, Joy; Neal, Philip. *The Handbook of Environmental Education.* New York: Routledge Press. (1994). Pg. 56.

How a student will be assessed should be shown from the beginning, so that the teacher can evaluate each child constantly. Assessment throughout the lesson is vital to test if the student learned the material and will be able to progress to the next phase of the class.[218] The lesson has multiple steps and the teacher should not to move on until he or she is confident that the class has mastered each concept. Thus, assessments come not just at the end of the lesson but also during each step. Participation is crucial because this lesson is at its most basic, an ethical debate. Students should feel comfortable enough to express their opinions because they will learn little just listening to the ideas of the teacher. The teacher should also try to remain as neutral as possible by just teaching the facts so that students can create their opinions only after hearing the evidence. The letter to Congress is very important because it allows students to become a part of the political process. By assigning this activity, a teacher is not only able to help students cultivate their own opinions but also express them eloquently and perhaps even see an effect of this effort, such as a letter in return from their Member of Congress.

LESSON BACKGROUND

Relevant Vocabulary:

- ***Distill:*** *to let fall, exude, or precipitate in drops or in a wet mist.*[219]
- ***Enzyme:*** *Any of numerous complex proteins that are produced by living cells and catalyze specific biochemical reactions at body temperatures.*[220]
- ***Ethanol:*** *A colorless volatile flammable liquid C_2H_5OH that is the intoxicating agent in liquors and is also used as a solvent and in fuel.*[221]
- ***Glucoamylase:*** *An enzyme that breaks the bonds near the ends of large carbohydrates*

[218] Palmer, Joy; Neal, Philip. *The Handbook of Environmental Education.* New York: Routledge Press. (1994). Pg. 159.
[219] "Distill Entry." *Merriam-Webster Online Dictionary.* Retrieved June 13, 2011 from http://www.merriam-webster.com/dictionary/distill
[220] "Enzyme Entry." *Merriam-Webster Online Dictionary.* Retrieved June 13, 2011 from http://www.merriam-webster.com/dictionary/high%20fructose%20corn%20syrup?ref=dictionary&word=enzyme#
[221] "Ethanol Entry." *Merriam-Webster Online Dictionary.* Retrieved June 13, 2011 from http://www.merriam-webster.com/dictionary/ethanol?show=0&t=1307986366

(starches), releasing maltose and free glucose.[222]

- ***Yeast:*** *a yellowish surface froth or sediment that occurs especially in saccharine liquids (as fruit juices) in which it promotes alcoholic fermentation, consists largely of cells of a fungus (as the saccharomyces, Saccharomyces cerevisiae), and is used especially in the making of alcoholic liquors and as a leaven in baking.*[223]

Background Information:

The search for a viable alternative to fossil fuels has been fraught with difficulty. In the United States of America, society is so dependent on fossil fuels to run cars and factories that we lose sight of the amount of harmful byproducts that are pumped into the air every day. It is increasingly understood that finding an alternative way to run industry and transportation is of the utmost importance. Suggestions have been made and many of them, such as solar power, hydrogen power and ethanol, have been incorporated into transportation and industry on a small scale. However, each of these sources has failed to gain widespread use because of the objections that erupt from a variety of special interest groups. This issue is particularly evident in the case of ethanol.

Ethanol is a fuel made from plant products. It is considered a renewable energy source because it depends upon the growth of a plant which, at the most basic level, only needs sunlight, soil and water to grow. Ethanol can be made from an enormous variety of plant life, usually feedstock, such as switch grass, cane sugar and sugar beet, among others. In the United States, ethanol fuel is most often made from corn. The corn is harvested, ground, and taken to a site where it can be chemically converted to ethanol alcohol by a process of heating and cooling. Gasoline is then added to ethanol liquid to make a blend of either 10% ethanol (which can be used in any car made after 1980 to improve performance and slightly decrease the amount of greenhouse gases emitted from the burning of the gasoline) or a higher concentration such as 85% which can be used only in cars specially fitted to run on ethanol.[224]

Making ethanol from corn becomes a highly contested issue when you consider corn as a popular food crop as well as the basis for fuel. Corn is a staple of the American diet and channeling large amounts of this crop into fuel would affect a high percentage of the foods that we eat everyday. Global debates over corn as food versus corn as fuel have opened up over the past decade as the use of ethanol has grown and continues to do so. Domestically, people in support of using ethanol fuel say that it is an excellent fuel source because it burns cleaner than gasoline and would help reduce the U.S.'s dependence on foreign oil. They are also optimistic that it will provide more domestic jobs because it will open up a new sustainable market to corn farmers. This type of fuel offers stability because, unlike fossil fuels, it will never run out as long as the sun shines and farmers can irrigate their fields.

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[222] "Glucoamylase Entry." *The Enzyme Experts.* Retrieved June 13, 2011 from http://www.enzymeexperts.com/index.php?option=com_glossary&func=display&letter=G&Itemid=26&catid=13&page=1

[223] "Yeast Entry." *Merriam-Webster Online Dictionary.* Retrieved June 13, 2011 from http://www.merriam-webster.com/dictionary/yeast?show=0&t=1307987172

[224] "How Ethanol is Made." *Ethanol Promotion and Information Council, Inc.* Retrieved June 14, 2011 from http://www.youtube.com/watch?v=59R-NqykoXs

On the other hand, opponents of this energy source say that as long as global hunger is such a significant issue, the United States should not divert food that could be used to feed the hungry to power our vehicles, and thus our consumerist lifestyle. They also fear that the use of corn for fuel would drive up the price of corn for food, thus making it more difficult for lower and middle class Americans to afford to feed their families. Others claim that ethanol would not really diminish our reliance on fossil fuels at all because it takes a lot of fossil fuels to produce and transport ethanol.

Many arguments exist on all sides of this issue. In June 2011, the Senate showed where it stood on this debate by voting down a measure that would have eliminated federal subsidies for ethanol made from corn, but Capitol Hill has not heard the last of ethanol.[225] It is clear that this debate will not be settled easily. This lesson will help students examine the facts behind this issue and understand that there is no right or wrong answer. Students will be guided towards forming an intelligent opinion, but will realize that this is a very complex issue that will not be solved over night.

The background information is perhaps the most important part of an environmental lesson because many teachers will be coming to the classroom with very little experience teaching for environmental literacy. They have likely not been trained in these subjects so it is important to supply *more* information than is strictly necessary for the lesson. In this case, the processes and uses of ethanol are important to note, and it is equally important to inform the teacher about all sides of the debate so that he or she can give the class proper information, especially on such a volatile subject that could be discussed in an emotional rather than a logical manner. Additionally, this subject in particular, but really the majority of environmental topics, have received quite a lot of media attention and as such, students may be joining the discussion with already held viewpoints from information gleaned outside of class. Some of this information is bound to be from unreliable sources.[226] Thus, it is vital that the teacher has a firm grounding in all of

[225] "United States Senate Votes Down Ethanol Subsidies." *Humanitarian News*. Retrieved June 18, 2011 from http://www.humanitariannews.org/20110617/us-senate-votes-down-ethanol-subsidies-afp
[226] Palmer, Joy; Neal, Philip. *The Handbook of Environmental Education.* New York: Routledge Press. (1994). Pg. 56.

the facts of the subject so that he or she can clear up any student misconceptions *before* the debate begins.

LESSON STEPS

Warm-up: What can Corn do?

1. *Begin this lesson by passing out* ***Reproducible #1 – Where is Corn Hiding?*** *Allow students five minutes to mark which items on the list they think contain corn or corn products.*
2. *After everyone has finished, tell the class that in fact every item on the list contains corn in a variety of different forms (high fructose corn syrup, corn meal, corn starch, etc.). Lead a discussion about the activity. Which items were the students surprised contained corn? Answers: will vary. Why do they think that corn is such an important crop in the lives of Americans? Answers: Subsidies, lots of land well suited to grow it, is extremely versatile and can be used to support many other industries such as growing livestock, etc.*
3. *Ask students if they think using corn in the majority of the foods the American public eats is a bad thing. Why or why not? Answers: It is not very healthy, makes the country wholly reliant on a single crop, makes junk food cheaper than healthy food because of corn subsidies, etc.*
4. *Next, ask the class what they know about ethanol as an alternative fuel source. Make a list on the board of facts the students come up with. Once students have answered, fill in the gaps by explaining that ethanol is a liquid fuel that can be made from a variety of plant sources such as corn, sugar cane, switch grass and many others. Explain that ethanol is considered a renewable energy source because it relies on plant matter, which needs only soil, sun and water to grow. In the United States, ethanol is usually made from corn; the very same corn that was used to make all of the items on the list.*
5. *Present the first three minutes of the video "How Ethanol is Made"*[227] *by the American Coalition for Ethanol.*
6. *Allow time for questions about the video.*
7. *Explain that the issue of using corn for food versus corn for fuel is a much-contested question in American politics and that there are many arguments in the debate. Ask students what their initial thoughts are about using corn for fuel versus corn for food. Do they think one use is more important than the other?*

Activity One: Food vs. Fuel Debate

1. *Now that students have a basic understanding of what ethanol is and why it is a difficult and multi-faceted issue, they have the right tools to begin to delve deeper into*

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[227] "How Ethanol is Made." *Ethanol Promotion and Information Council, Inc.* Retrieved June 14, 2011 from http://www.youtube.com/watch?v=59R-NqykoXs

the debate. Inform students that the following day they will all be participating in a class debate about the issue of using corn as a food or fuel source. However, they will not be playing themselves, but rather one of a group of societal actors to whom this issue is very important.

2. *Ask students what types of groups they think have a vested interest in the ethanol debate and why. Keep a list on the board of all suggestions. Once students are stumped, add any missing actors from the list below and explain what their interest is in this debate.*
3. *Next, tell students that they will be each assigned to play one of these characters in the debate. They will have to figure out the point of view their character would take on this matter and why. They will also need to do research so they can support their claims accurately. A breakdown of the characters is below; the teacher may also add characters that students brainstormed previously.*
4. *Assign each student a role to play in the debate. The roles are as follows:*
    - *Members of Congress (3-5 students)*
    - *Government Officials (1-3 students)*
    - *Small corn farm owner (1-3 students)*
    - *Large agriculture industry supported farmer (1-3 students)*
    - *Agriculture industry spokesperson (1-3 students)*
    - *Pig farmer (1-3 students)*
    - *Scientist (1-3 students)*
    - *Middle class American parent (1-3 students)*
    - *World Hunger Activist (1-3 students)*
    - *Environmentalist (1-3 students)*

    Depending on the size of the class, each role may have a different number of students as listed above but make sure each role has at least one student. If the class is very small, the teacher can play the role of Congress to ensure that there are enough students to fill all the other roles.
5. *Give each student a copy of* ***Reproducible #2 – Food vs. Fuel Debate Roles*** *to help them begin an investigation into their characters.*
6. *Tell the students that for the remainder of the class period and for homework that evening they must prepare to play their assigned roles in the debate the following day. Tell them that "Congress" is currently debating a piece of legislation that would outlaw using corn to make ethanol. Congress has requested the presence of each character to help make the decision leading up to a vote at the end of the day. Students assigned the same character will have to work together to develop a cohesive argument and each group will be given five minutes to explain their position before Congress. After a single student or group of students presents their argument, Members of Congress will have one minute to ask the questions they prepared beforehand. Tell students that the objective of the debate it to convince Congress to vote in their favor. Students should be as persuasive as possible by using important facts and information. Encourage students to play their parts as though they were real people (including real-life examples, props and costumes). Remind students that if they are in a group of two or more students, they should distribute the work equally and each student should have a turn to speak during the presentation.*

7. *Give each student a copy of **Reproducible #3 – Corn: Food or Fuel Debate Rubric** to outline all of the requirements for the lesson. Explain that they will have to turn the rubric in at the end of the activity with the self-assessment column filled in.*
8. *Allow students the remainder of the class to begin research with books and Internet sources including those suggested on **Reproducible #2 – Food vs. Fuel Debate Roles**. Students playing actors should research their particular character's position, while students playing Members of Congress should brainstorm pertinent questions to ask each actor after their presentation.*
9. *Next class period, arrange the classroom so that the Members of Congress are sitting at the front and there is a space for characters to speak to Congress and the rest of the class.*
10. *Introduce the debate by reminding students that Congress is due to vote on a bill that would outlaw using corn to make ethanol. Congress has asked many different groups to explain their position on this issue. At the end of the debate, Congress will use the information it learns from each group to make its final decision. Each group has five minutes to speak and must answer Congress's questions for one minute afterwards.*
11. *Use a stopwatch to accurately time each presentation and question session directly following. Allow five minutes for each presentation and one minute for questions from the Members of Congress. Depending on the length of the class, presentations might extend into the next day.*
12. *After each character has presented, tell the class that now that Congress has listened to all the evidence, it is time for them make their final decision. Allow Congress five minutes to discuss their decision among themselves. After a conclusion has been drawn, Congress should make a short presentation to the class stating its decision and briefly why it was chosen.*
13. *For homework, students should write a short letter (2-3 pages) to their real Member of Congress about where the student personally stands on this issue. The letter should be in a formal letter format, and include scholarly information with proper citations. Remind students that this letter does not necessarily have to reflect the viewpoint of their assigned actor, but rather their personal ideas after listening to each presentation in the class Congress session. Explain that letters to a real Member of Congress really can have a big effect on that Member's political decisions and thus the letter should be taken seriously and executed professionally. After all students have turned in their letters, send them to the local Member of Congress.*
14. **Optional: Have students present their letters for the class on the day they are due.*
15. *Have students fill out the self-assessment portion of **Reproducible #3 – Corn: Food or Fuel Debate Rubric** and hand in along with their letters.*

The most important aspect of this lesson is that it should be led by the class, rather than just by the teacher. The teacher should provide questions but very few answers. Environmental learning should consist of exploring, and eventually satisfying, one's

curiosity. It is necessary for the teacher to explain some concepts, such as how ethanol is made because it is unlikely that students would be able to derive this knowledge by themselves. However, students should investigate other parts of the lesson on their own. This lesson is effective because it is not purely lecture based. Palmer and Neal cite that lesson plans for environmental literacy will "provide accurate, up-to-date and unbiased information, well matched to the abilities and existing knowledge of the learner; they will be interactive in the sense that they will engage the learner in thought-provoking and stimulating tasks; and they will encourage reflection, debate and decision making rather than merely providing 'the right answer.'"[228]

Wrap Up: Review the Pros and Cons

1. *Make a class list of the pros and cons of using corn as a fuel source. Allow students to contribute as many ideas as possible. Keep a list of all ideas on the board. Pros include cleaner and more sustainable than fossil fuels, larger market for corn farmers, renewable, etc. Cons include creates higher food prices, uses fossil fuels in production and transportation, creates less energy than normal gasoline, etc.*
2. *Next, ask the class to make a list of the pros and cons of using corn as a food source. Keep a list of all ideas on the board. Pros include easy and cheap to grow, plentiful amount of land on which to farm it, can be used in a large variety of products, is a native species, etc. Cons include its use as a variety of unhealthy sweeteners (such as high fructose corn syrup), extreme dependence on a single crop, etc.*
3. *Ask students if they think it is possible to ever settle this debate in a fashion that would satisfy everyone? Why? Do they have any ideas for a compromise that could allow corn to be used as both food and fuel in an equitable way?*

Wrapping up the lesson is a good way to brainstorm solutions to an issue or guide the class to the possibility that there is no perfect solution. It is important in environmental learning to acknowledge that most environmental issues will not be solved overnight and may take the cooperation of a variety of groups before a resolution can be reached.[229]

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[228] Palmer, Joy; Neal, Philip. *The Handbook of Environmental Education.* New York: Routledge Press. (1994). Pg. 57.
[229] Ibid. Pg. 53.

Asking the class to brainstorm their own solutions and then assess them to determine the ways in which these solutions might be acceptable or problematic allows students to appreciate the difficulty of solving environmental problems. This will enforce the idea that these issues involve many other subject areas and groups of people, not just those concerned about the environment.

Extension: Are There Other Options?

1. *Have students research other forms of alternative energy (such as hydrogen, solar, etc.) and compare and contrast it with ethanol. Which is a more viable option? Why?*
2. *Assign students to keep a journal of the food they eat for three days. After they eat each item, have them check the ingredient list to see if corn or a corn product is included. Give them a list of tricky ingredient names that are likely to mean the item contains corn (such as hominy, masa, maltodextrins, sorbitol, vinegar, dextrose, food starch, vegetable starch, baking powder, maize, dextrin, vegetable gum, modified gum starch, and vegetable protein.) How much of what they eat is made from corn? Does this change their opinion on the debate?*
3. *Research and create a presentation on a city that uses an alternative energy source to power some part of its infrastructure (such as a public transportation system). Suggested cities include Rio de Janeiro, Brazil; one of the solar cities in Australia; etc. What part of these systems has been successful? What, if any, problems have arisen? How could the system be improved? Does it seem possible to create a similar system in the United States?*

It is also vital that exploration of the subject does not stop when the bell rings. Assigning follow-up tasks in which students have freedom to explore a topic that interests them is a good way to create excitement about the field. Additionally, activities such as the second one above allows students to examine the ways in which they personally are a part of the issue so that they can make small changes in their life. This teaches the idea that individuals must be held accountable for their own actions and the ways in which they affect the planet.

CONCLUSION

In this lesson, students examined the process of turning corn into ethanol fuel. They also explored the contentious issue of the food vs. fuel debate. By researching this topic, students took part in a current political issue to help deepen their knowledge of government. Students critically analyzed this issue to develop strong and persuasive arguments that were presented to their peers. By the end of this lesson, students were encouraged to draw their own conclusions about this issue and present them in a letter of opinion to their Congressperson to engage their civic responsibility.

This lesson incorporates science, environmental studies, and social studies into one. It demonstrates that it is possible to incorporate education for environmental literacy into a large variety of subjects and still teach students the basic skills they need to be successful and satisfy state education requirements (such as those in reading, writing, and math). In this case, students are required to develop their writing skills by writing a formal letter to a representative in Congress. If students do not have experience writing in a formal letter form, the teacher would need to brief them on this procedure, which is not only useful for standardized writing tests (which often assume that students have experience with a variety of different writing styles) but will also be useful later in life as a student applies to college or the workforce. Students also gain experience in conducting research. In this lesson, they must investigate the opinions of the actor to which they have been assigned, most certainly on the internet and perhaps in newspapers and other periodicals as well. Although teachers are encouraged to give students a few helpful websites to get them started (see full lesson plan in appendix) they will undoubtedly need to use their research skills to determine which other websites to use as well as how to distinguish fact from fiction. Students must learn not to trust absolutely everything they read online and this activity is a good exercise in analyzing sources to determine how reliable they actually are. This will serve students well later in life too, when they are required to conduct research for a job or in an institution of higher education.

To provide an even more comprehensive application of the ways in which environmental education can be incorporated into just about any subject, we shall turn to a plan for environmental learning that was originally designed to show teachers the variety of ways to teach for environmental literacy. This model acknowledges just how in-depth environmental learning in school should be; for it outlines nine specific categories by which one environmental idea should be addressed. These categories are curriculum content, practical work in and outside the classroom, afterschool activities, school grounds and buildings, special timetable activities, events, assemblies, contribution to environmental audit (to display student progress) and support from other subjects (to create a multidisciplinary approach).[230] By examining *just* the portion on curricular content, it is possible to see the magnitude of opportunities for environmental learning that a school could present to its students. This specific outline covers only the issue of ground level ozone and ozone layer depletion to show how this environmental science topic can actually be incorporated throughout the school.[231] For example, this plan suggests including a history lesson on the industrial revolution, the oil crisis and the invention of the atom bomb.[232] In geography, the plan proposes that the class should study where on the globe ozone depletion is the worst and what effects this has had on nature and society.[233] In math, a class could graph ozone depletion rates or examine how quickly trees grow in polluted environments.[234] Even English was included, suggesting reading 'green' poetry or

[230] Palmer, Joy; Neal, Philip. *The Handbook of Environmental Education.* New York: Routledge Press. (1994). Pg. 234.
[231] Ibid.
[232] Ibid. Pg. 236.
[233] Ibid.
[234] Ibid. Pg. 238.

examining the way that the news media has addressed the issue.[235] This plan sites an enormous variety of other ways to make environmental learning part of the normal curriculum. This outline exemplifies the fact that it is not necessary to sacrifice typical learning models in order to incorporate the environment into schools.

Finally, this plan also suggests ways to get the students involved in the school environmental audit. This strategy is twofold because it both measures the student's progress on the path to environmental literacy as well as allows the school to glean valuable information about the sustainability of their institution. Students could, for example, examine the transportation methods that students take to go to school.[236] How many kids walk or use public transportation? Do many students arrive in single occupancy vehicles? How might these patterns of mobility affect the air quality near the school and in the surrounding town? Then students could organize campaigns to encourage change that they deem necessary after careful research and brainstorming. In this case, perhaps encouraging students to carpool or ride their bike to school instead of driving by themselves would be a viable option. This is an excellent way to get students involved in what they are learning while raising awareness of environmental issues in the larger student community. Encouraging students to put their newfound knowledge into action that will affect their community is perhaps the most important aspect of these classes.

Environmental lesson planning simply takes a lot creativity and motivation. It is clear that environmental education as a curricular initiative does not have to replace, or even take time away from, the typical subjects that the government, community and school

[235] Palmer, Joy; Neal, Philip. *The Handbook of Environmental Education.* New York: Routledge Press. (1994) Pg. 238.
[236] Ibid. Pg. 249.

officials traditionally emphasize. Rather, teaching all subjects through the lens of environmental analysis can have spectacular results, leading to greater environmental awareness, enhanced student involvement in the school community and the nurturing of skills that will help students act as environmentally conscious and influential citizens.

How Can Schools Start to Implement Environmental Literacy Plans?

Fundamental changes to school campuses, cafeterias and curricula on the scale that I have advocated here do not happen overnight. To make meaningful changes in public schools that would promote environmental literacy, the education system must transform on micro and macro levels. These changes can be undertaken in small steps over time (perhaps the most realistic model) or as complete overhauls of the way that the entire system works and the way in which the American people value the education of their children. Large-scale public reforms take time and quite a lot of effort. Historically, it has been difficult to reform public institutions and societal beliefs. Thus, it is important that we start as soon as possible in order to have a chance of changing our schools for future generations.

This type of change can take two forms. Education *reform* refers to an attempt "to correct a deficiency in the current educational system without changing the essential elements of the system."[237] Within the framework of environmental literacy, this means that the basis of public education would be left the same, but environmental lessons and ideas would be infused into this already functioning system. Reform by way of multidisciplinary additions to already existing curricula could be very effective. This is a

[237] Horn, Raymond Jr. *Understanding Educational Reform: A Reference Handbook.* ABC CLIO: Santa Barbara. (2002). Pg. 2.

good place for the movement for environmental literacy to start. In sharp contrast to the reform method however, educational *change* refers to a complete alteration of they way the system functions, leaving "the educational system significantly different than before the change initiative."[238] As it applies to environmental literacy, this would imply that schools need to alter the subjects taught or the method of learning to focus much more on environmental education, instead of merely incorporating it into already existing systems. Clearly, either of these methods would be useful in implementing environmental literacy initiatives, but it is important to be realistic in setting goals for change while recognizing that these processes can take many years. In a different world-- in which funding was abundant, all citizens were firmly behind environmental stewardship and the public education system did not suffer from any other serious structural flaws--I would advocate for educational change to reflect the principles of environmental literacy. It is my hope that one day environmental education will be mandated on the federal level and that the ways it is taught will be effective and widespread so that all children will receive the education they deserve. However, in the world we are given to work with today, I think environmental reform at the local level may be the best starting place.

The duties that a school must fulfill are significant and varied. As Raymond Horn, an expert on educational reform argues: "the many different purposes that our schools are asked to achieve within the changing demographics of our society are further complicated by society's demand that these purposes should be achieved within the context of free and compulsory elementary and secondary schools. In addition, schools are asked to

[238] Horn, Raymond Jr. *Understanding Educational Reform: A Reference Handbook.* ABC CLIO: Santa Barbara. (2002). Pg. 2.

accomplish this task regardless of all the individual differences of their students that result form economic, racial, ethnic, and gender diversity. In the face of this challenging diversity, schools are asked to foster social equality, promote the full creative potential of their students, and integrate these diverse individuals into the social order."[239] Clearly, public schools have no shortage of worries and difficult tasks ahead of them but, if we hope to bring environmental education into at least some classrooms *before* it is officially mandated, it will be important not only to identify all of the benefits of environmental literacy, but also to have comprehensive plans for schools to incorporate this critical subject into the classroom without too much added strain on teachers, kids, administrators or budgets.

To affect significant change, I have identified three important steps. The first is to create a mission statement that is centered on the task that a school wishes to accomplish.[240] In this way, everyone who works and learns at the school would be aware of the goal of environmental literacy and have a purpose in their everyday endeavors. Many schools already have mission statements, but all the public schools I have attended had vague statements that did not set any real goals and that no one actually had committed to memory. For instance, my high school's mission statement is: "Pride in what we do, excellence in how we do it."[241] Although pride and excellence are honorable goals, this mission statement says next to nothing about what is actually going on in the school. It gives neither the teachers the information to teach with purpose nor the students any

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[239] Horn, Raymond Jr. *Understanding Educational Reform: A Reference Handbook.* ABC CLIO: Santa Barbara. (2002). Pg. 13.
[240] Brocu, Lisa and Merriman, Tim. "From Mission to Practice." *Free Choice Learning and the Environment.* Edited by: Heimlich, Joe; Falk, John; Foutz, Susan. AltaMira Press: Plymouth. (2009). Pg. 77.
[241] http://shs.sno.wednet.edu/files/1212/9916/9109/Course%20Description%20Book%2011-12-Final%20update.pdf

indication of what type of education they will receive. This mission does not standardize any goals and thus it is unlikely that students will graduate with any sort of conviction about what they learned. To accomplish a goal, it is important that everyone involved recognizes this goal and is able to verbalize it, for without this understanding it is very difficult to incorporate steps to achieve this objective into their daily routines.[242]

This same principle has been used by a variety of organizations outside of public schools. Both non-profits and for-profit corporations with a distinct vision have used this technique to achieve their goals.[243] One such example of a corporation that has been wildly successful with this strategy is Disney. Every member of the staff of Disney World, from night janitors to costumed characters to information-technology gurus, is trained around its mission, "We create happiness by providing the finest in entertainment to people of all ages, everywhere."[244] All of the employees of the company have memorized this mission and everything they do in their daily jobs is supposed to be done with that mission in mind.[245] Perhaps this is why Disney World has been so successful in marketing itself as "The Happiest Place on Earth."[246]

Public schools could learn from these successful mission statements. In a school's quest to incorporate environmental learning into the daily lives for their students, it is important to start with incorporating it into their mission statement and ensuring that all teachers and administrators are aware of the school's short and long term goals. If this is

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[242] Brocu, Lisa and Merriman, Tim. "From Mission to Practice." *Free Choice Learning and the Environment.* Edited by: Heimlich, Joe; Falk, John; Foutz, Susan. AltaMira Press: Plymouth. (2009). Pg. 77.
[243] Ibid.
[244] Ibid. Pg. 78.
[245] Ibid.
[246] Ibid.

the case, teachers will have a better idea of what is expected of them and will have a guiding principle to use in their classroom. It is also important that all teacher training be centered around a school's mission statement, and that the students too are aware of what the vision for their education is at their particular school. Because shorter mission statements tend to be more effective for all members of the community[247] (as well as easier to teach and learn) simply incorporating the idea of environmental literacy into a single sentence could be effective. For example, an ecologically sensitive mission statement could read, "Our school strives to provide a safe, sensitive, and enjoyable learning environment for children where they are given the tools to become productive, caring, and environmentally literate citizens." This places the goal of environmental literacy at the forefront of the schools ideological convictions and practices without having to eliminate other aspects of a successful school mission. On a smaller scale, it could be helpful for teachers to post classroom missions that they brainstorm with their students in their own classrooms. These missions may be slightly different than that of the school as a whole, but could be more kid-friendly by incorporating the ideas of students about what the goals of their educations should be and how they could achieve them. In this way, everyone within the school could be at least aware of the goal of environmental literacy, even if only small steps are taken to meet these goals.

Once a school mission is in place, a framework that motivates schools, individual teachers and classrooms to become environmentally literate is also necessary. Maryland is the only state that has created a regulation requiring environmental education, and even

[247] Brocu, Lisa and Merriman, Tim. "From Mission to Practice." *Free Choice Learning and the Environment.* Edited by: Heimlich, Joe; Falk, John; Foutz, Susan. AltaMira Press: Plymouth. (2009). Pg. 78.

this system has yet to find an effective manner in which to implement and measure the success of the initiative.[248] The official text from the Maryland Secretary of State simply reads, "Each local school system shall provide in public schools a comprehensive, multi-disciplinary environmental education program infused within current curricular offerings."[249] This marked a huge step ahead for the environmental education movement, but is nevertheless problematic because the State Education Department has not yet agreed upon a plan to meet this goal and thus has no way to aid teachers in fulfilling this requirement nor enforce it fairly. It is important for any school wishing to educate for environmental literacy to brainstorm a comprehensive plan for their initiative so that goals can be created and met. This is not to negate the efforts that Maryland has made towards establishing environmental literacy as a state goal, but until it is mandated across the entire country and an approved curriculum written by experts in the field is implemented, the future of its actions will remain within state borders.

There is hopeful news however. Recently, the U.S. Department of Education recognized the need for a framework that provides ideas for school greening as well as an incentive-based program to teach for environmental literacy. The Green Ribbon Schools Program, launched in 2011, encompasses curriculum, building, environment and food.[250] This is a program that "will recognize schools that save energy, reduce costs, feature environmentally sustainable learning spaces, protect health, foster wellness, and offer environmental education to boost academic achievement and community engagement. The

[248] Environmental Education Instructional Programs for Grades Prekindergarten-12 Grade." *Office of the Secretary of State of Maryland.* Retrieved July 26, 2011 from http://www.dsd.state.md.us/comar/comarhtml/13a/13a.04.17.01.htm
[249] Ibid.
[250] http://www2.ed.gov/programs/green-ribbon-schools/

recognition award is part of a larger U.S. Department of Education effort to identify and disseminate knowledge about practices proven to result in improved student engagement, academic achievement, graduation rates, and workforce preparedness, as well as a government-wide aim to increase energy independence and economic security."[251] This program encompasses three main pillars of environmentally aware schools: environmental impact and energy efficiency, healthy school environments, and environmental and sustainability education.[252] The category of "environmental impact and energy efficiency" incorporates sustainable efforts in recycling and waste, water conservation, transportation methods, and reduction in greenhouse gas emissions.[253] "Healthy school environments" focuses upon healthy food and fitness plans for students, safety of all people within the building and maintenance of grounds.[254] Finally, "environmental and sustainability education" pertains to school wide efforts to promote interdisciplinary learning, community outreach, and future planning.[255]

Schools are encouraged to make whatever small changes that they can across the school to work towards excellence in one or all of these categories. Each year, leaders of state and Indian reservation educational offices are allowed to nominate up to 4 schools that they believe have made a substantial effort to promote environmental literacy on their campuses. At least one of these schools must be made up of at least 40% students of disadvantaged backgrounds (although the meaning of disadvantaged backgrounds is not

[251] http://www2.ed.gov/programs/green-ribbon-schools/
[252] http://www2.ed.gov/programs/green-ribbon-schools/eligibility.html
[253] Ibid.
[254] Ibid.
[255] Ibid.

readily defined in the instructions).[256] From these nominations, the U.S. Department of Education can then give Green Ribbon School Awards to schools that have shown initiative and made progress with the resources that they have available to them. This program is not only for schools that have state-of-the-art sustainable technologies, but also for any school that has made changes, no matter how small, to make their school more environmentally literate. This program provides incentive for all schools to "go green" because awards from the Department of Education give schools a sense of pride in their accomplishments. A national acknowledgement may also make schools more attractive to families considering moving to the area.[257] This award may lead to neighborhood campaigns of urban renewal, as the Blue Ribbon School Award Program for improved academic achievement has been shown to do.[258] If the school made a concerted effort to involve the students and community in their greening projects, the school will become a source of community pride and students will recognize that their efforts for sustainability did pay off.

In addition to this national program, there are also state Green Ribbon School Programs that give out similar, although less prestigious, awards. Texas has a very comprehensive and public school-friendly program that lays out a specific format schools can use to apply for the award. This award identifies four categories: nature adventure, eco-campus, health and fitness, and natural classrooms.[259] For each of these categories, the website suggests a variety of activities that a school could do that would fit into that

[256] http://www2.ed.gov/programs/green-ribbon-schools/eligibility.html
[257] http://www2.ed.gov/programs/nclbbrs/index.html
[258] http://www2.ed.gov/programs/green-ribbon-schools/faq.html#question2
[259] http://www.greenribbonschools.org/earn-award.php

specific discipline, such as harvest rain water or put on a school Earth Day celebration.[260] Schools can also create their own activities and then log them on their school profile on the website. When a school has completed at least one activity in each of the four categories, they are eligible to win the award.[261] This system is helpful for schools that do not know where to start incorporating environmental literacy and need as many helpful suggestions as possible. The activities are all fun as well as instructive so that kids will want to participate. The website is also very kid-friendly, so students could take the lead on this project for their school.[262]

It is initiatives such as these that will help boost the country into full-blown environmental literacy plans. Obviously, not all schools will take part in free-form plans such as these, nor is it plausible to assume that all schools are aware of such helpful programs, but the more publicity these ideas get the better. Perhaps most importantly, through programs such as nation- or statewide Green Ribbon Schools Programs even schools with very little extra funding can incorporate green learning into their daily schedule and feel good about the progress they make. In this way, no matter what ethnicity, socioeconomic class, or region a student is a part of; he or she can have access to the same educational ideals and practices as students in more prestigious schools. Green Ribbon School Awards can act as the antidote to the other certification processes, such as LEED, that judge a school more upon the amount of money they are willing to put forward for sustainability instead of what really matters to a student's education: a

[260] http://www.greenribbonschools.org/earn-award.php
[261] Ibid.
[262] http://www.greenribbonschools.org/

multidisciplinary approach that allows a community to think locally and globally about environmental education.

Lastly, there must be a method for monitoring progress in schools. Because federally or state mandated environmental education may be a long way off, a school that prioritizes sustainability still needs to be able measure the effectiveness of its strategies and make changes if the students are not learning as much as they should be from the program. Without a monitoring system, new reforms put in place could be ineffective, or even produce more harm than good, and no one would ever know.

When a school district needs to achieve and measure results, state leaders often first jumps to standardized tests.[263] These tests are considered to be the most efficient and fair manner in which to test a new curriculum or any progress made by individual students or students as a population in a particular class or school.[264] However, these tests are not without flaws. There has been much debate in recent years about the effectiveness of standardized testing as it applies to topics such as math, reading, and writing. Some concerned parents and scholars see the standardized test as, "a creature in one of those old horror movies that threatens to swallow our schools whole."[265] It is true that although testing is a traditional way of accessing student knowledge, students in schools in 2011 are forced to take many more tests than their predecessors, many of which are completely multiple-choice based.[266] America is one of the only countries to employ multiple-choice

[263] Benjamin, Richard and Hanes, Susan. "Transforming Public Education: Sustaining the Roots of American Ideals, Our Economy, and Our Environment." *Education for a Sustainable Future.* Edited by: Wheeler, Keith and Bijur, Anne. Kluwer Academic Publishers: New York. (2000). Pg. 171.
[264] Ibid.
[265] Kohn, Alfie. "Standardized Testing and Its Victims." *Education Week*. Vol 20, No.4. (2000). Pg. 1.
[266] Ibid.

versions of standardized tests at any grade level.[267] In our public schools, these standardized tests are currently administered to kids of all ages and have been shown to not be an accurate test of a student's true knowledge because they can be affected by a variety of other factors in a student's life.[268] Approximately 89% of score differences between students are attributed to outlying factors such as parental educational background and the poverty level of the child in question.[269] Thus, a standardized test is not a true measure of how much a student has actually learned about a specific subject. Standardized testing is especially inefficient for testing environmental literacy because standardized tests often reward students for so called "superficial thinking," which involves the child parroting back facts that they memorized before hand, guessing on questions they do not know and skipping over hard portions instead of thinking critically and giving their best but honest effort.[270] Students that used such techniques typically scored higher on tests like the Comprehensive Test of Basic Skills, which is then interpreted to mean that they have a higher-grade level proficiency.[271] Teaching for environmental literacy however, has so many components that cannot accurately be tested in this way. Certainly part of environmental education is the memorization of facts, just as in any other subject. However, a critical aspect of being environmentally literate is being able to think critically about the world around you and how you as an individual interact with that environment. It seems unlikely that a standardized test would be able to accurately measure this concept of mastery and application.

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[267] Kohn, Alfie. "Standardized Testing and Its Victims." *Education Week*. Vol 20, No.4. (2000). Pg. 1.
[268] Ibid.
[269] Ibid.
[270] Ibid.
[271] Ibid.

There are many more effective ways to measure proficiency within green schools. It is important to measure the success of each individual sector of a school that teaches for environmental literacy: food, gardens, buildings and curricula, in one's quest to monitor and measure the success of green school initiatives. In curriculum development and implementation as well as garden based learning, the student should be the center of the measures of success. If a standardized test was administered after a unit on an environmental topic, this would surely show *what* a student knows, but it would be very difficult to determine exactly *how* this information has impacted their life presently and in the future. Because environmental literacy is centered on responsible action as the most advanced phase of learning, it is important to measure students success by their changing attitudes and how they display these in their daily lives and in the community. One way that students can do this is to grade themselves on their own progress through self-assessment rubrics.[272] Students can sometimes be their own harshest critics and an honest assessment from the student has the potential to really measure understanding and changes in attitude. Assessment rubrics can also give teachers feedback about the parts of the lessons that students did or did not enjoy or find helpful. This provides insight into the best teaching practices and helps teachers prepare for next year. Another way to monitor a student's progress is through work and service portfolios.[273] Such portfolios serve as a place in which students can compile their work, not only from the classroom but also from time spent in the community and with their families. These could include writing samples, ideas for future projects, proud moments from the garden or when they taught a friend or

[272] Benjamin, Richard and Hanes Susan. "Transforming Public Education: Sustaining the Roots of American Ideals, Our Economy, and Our Environment." *Education for a Sustainable Future.* Edited by: Wheeler, Keith and Bijur, Anne. Kluwer Academic Publishers: New York. (2000). Pg. 175.
[273] Ibid.

family member an environmental lesson they learned in school. Additionally, journaling could be included in the portfolio, particularly during garden learning. Recording thoughts about the world around them, about current environmental issues, or about their activities in nature can be a great way to see exactly what students have taken in from the lessons and what has become important in their lives.

In the categories of green building techniques and lunchroom foods, testing the success of these programs should be both qualitative and quantitative. One way to satisfy both of these requirements is to have students, teachers, administrators and community members take part in an audit of the building or food system. Depending upon the ages of the students, more or less adult supervision may be necessary and this is a great way for a variety of age ranges to interact together and learn from one another. An audit can take many forms but could include a comparison of the amount of energy or water used since a greening measure was imposed, the number of sick days taken by students or staff, or the students' and community's knowledge and reaction to the new green school and cafeteria policies. In this way, not only is the quantitative data recorded, but it would also be possible to tell how the school at large feels about the adjustments and if they are helpful in education for environmental literacy. This would also be a very good exercise for the students conducting the audits, especially older students who would be able to take more initiative and learn how to collect unbiased data and draw conclusions from what they find.

In time, more schools will become involved in the movement for environmental literacy and a comprehensive plan involving such steps could be implemented in a systematic manner at schools across the country. At the beginning however, it is

important to pay heed to the experiences and advice of schools on the ground floor of the environmental education movement to decide what works best for implementation. Information like this will help to create the best possible plan for schools across the country. Programs like Green Ribbon Schools allow the government to highlight schools that have excelled in creating a sustainable school environment and allows other schools to learn from their techniques and experiences. A school environment should be a space in which sharing is used to its highest potential and in this way the country can create a movement among public schools to include learning for environmental literacy.

Conclusion

There is no getting around the fact that we only have this one Earth to inhabit. We were all born here and will all live here until the day that the planet can no longer support us. Beyond the political, societal and individual reasons for learning about the world around us and how to take care of it, lies perhaps the greatest truth that should motivate the public to crusade for environmental learning in the lives of all people across the country: humans are a part of the Earth. David Orr put this idea quite beautifully when he wrote, "We are the earth; our flesh is grass. We live in the cycle of birth and death, growth and decay. Our bodies respond to daily rhythms of light and darkness, to the tug of the moon, and to the change of the seasons. The salt content of our blood, our genetic similarity to other life forms, and our behavior at every turn give us away. We are shot

through with wildness. Call it biophilia (Wilson, 1984) or the ecological unconscious (Roszak, 1992), the earth is inscribed in us, we are of the earth."[274]

Upon reading that passage, I had to take quite a while to think about what exactly Orr meant. I rarely think of myself as an animal, as just another creature that came from the Earth and has been intimately tied to it for my entire life. It is my belief that very few humans are comfortable with this idea; we would much rather think of ourselves as separate from all other living things and inhabiting the Earth because we *can,* not because we *must*. Coming to terms with this idea may be the single most important catalyst for our society to begin preserving the planet upon which we have caused so much destruction.

This is where education for environmental literacy is of the utmost importance. What exists in our society today is a "causal disconnect."[275] It is not so much the lack of knowledge that is concerning, for information can be acquired within the frameworks that our schools have in place. More to the point, Americans are in the dark about the ways in which we are impacting the fragile and beautiful planet that we inhabit. Although learning the facts is a vitally important on the path to environmental literacy, "the goal is not to become an 'environmental encyclopedia.' Instead, environmental education is more about understanding important causal relationships – what might cause air and water pollution, the ramifications of recycling, what contributes to species loss, how different parts of a moving system affect one another, and about an individual's ability to sort out those

[274] Orr, David. *Earth in Mind: On Education, Environment, and the Human Prospect.* Island Press: New York. (1994). Pg. 204.
[275] Coyle, Kevin. "Environmental Literacy in America." The National Environmental Education and Training Foundation. Washington D.C. (2005). Pg. 14.

connections."[276] This is the key to why environmental education is important.

For these connections to be drawn, environmental education must be as complex as the Earth itself, to show just how much of an impact we have on our environment and similarly, the impact that our environment has upon us as a people. By greening all aspects of a school, from buildings and food, to lessons and gardens, students will learn to appreciate what parts of the natural world are necessary for their survival and happiness as well as how to care for them and the effects that poor environmental stewardship could have on their own lives and the lives of their children. Throughout this process, students and the schools they attend will reap the benefits that environmental education have to offer and in the long run, our society will see the advantages of having an environmentally literate group of people as national leaders.

This country needs to learn the facts: environmental education will have a positive impact upon the lives of students, families, communities, the nation and the entire world. By examining the ways in which the public education system has the capacity to incorporate environmental education into the school community on a multitude of levels, it is clear that environmental literacy for all students is a plausible goal for the future. This path will be difficult, but there is no better place to start than in the schools, where 18% of America's population spends seven hours each day learning.[277] Making education for environmental literacy a priority would be a revolutionary step on the way to healing the Earth and the societies in which we live.

Aside from all of these practicalities, there are still more benefits of environmental

[276] Coyle, Kevin. "Environmental Literacy in America." The National Environmental Education and Training Foundation. Washington D.C. (2005). Pg. 14.
[277] Kats, Gregory. "Greening America's Schools: Costs and Benefits." *Capital E Reports.* 2006. Pg. 4

education that cannot be as easily measured. I have been so drawn to this field because of the way that the natural world has affected my life and the lives of children I have taught. There really is no greater sight than the joyous smile that spreads across a child's face when she picks up a squirming worm for the first time or pulls a carrot directly out of the ground and takes the first bite, with bits of soil still clinging to the roots. Seeing a child in nature, learning to love the Earth and all of its wonders is inspiring, and considering the role of environmental education in the life of a single child makes it seem all the more possible. Imagine that young girl in the wheelchair at that Anacostia school garden as she reached down and touched the soil for the first time. Imagine how all of her senses must have been alive with the rich smell of the Earth, the grit between her fingers, the soft noise it made as it fell back to the ground. Imagine the awe she must have felt at the thought that nature had produced something so pure and remarkable and that beneath the concrete city she had always known existed these natural marvels. This is the true value of environmental education, for as Richard Louv wrote, "These are the moments when the world is made whole."[278]

[278] Louv, Richard. *Last Child in the Woods.* Algonquin Books: Chapel Hill. (2005). Pg. 310.

Appendix: Full Lesson Plan

This is a full lesson plan, including reproducible worksheets and rubrics, that I wrote for the Earth Day Network. This lesson plan was edited by Maggie Ollove, the Education Associate at the Earth Day Network and is also available at www.earthday.org.

CORN: FOOD OR FUEL?

INTRODUCTION

As increasing evidence points to the fact that the world's addiction to fossil fuels actually creates more problems than it solves, scientists all over the globe race to find new, sustainable fuel sources. Many ideas have been suggested, such as wind, solar or hydro power and each has varying levels of support, protest, financial and political backing, research and exposure. Perhaps one of the better known fuel types, largely because it has sparked a very heated debate, is ethanol: a liquid fuel made from plant matter. Although ethanol can be made from a number of different plants, in the U.S. it is most commonly derived from corn. This source of fuel has created a global conversation about the ethics of using food as fuel when parts of the world are still starved for both. In this lesson, students will learn how ethanol is made and delve deep into an examination of the pros and cons of its use. They will also participate in an academic debate and learn to speak persuasively to their peers. Finally, students will synthesize many different arguments to make a decision regarding their own stance on this important, yet highly volatile, debate.

LESSON OVERVIEW

Grade Level & Subject: Grades 9-12: Civics

Length: 2 – 3 class periods

Objectives:
After completing this lesson, students will be able to:

- Explain how ethanol is produced
- Describe the pros and cons of using corn as a fuel source
- Explain the attitudes of various groups involved in the corn as food vs. corn as fuel debate

Materials Needed:

- Stopwatch
- **Reproducible #1 – Where is Corn Hiding?**
- **Reproducible #2 – Food vs. Fuel Debate Roles**
- **Reproducible #3 – Corn: Food or Fuel Debate Rubric**

Assessment:
Students will be assessed through the following activities:

- Participation in class warm up and wrap up discussions
- Participation in the class debate
- Completion (and presentation if applicable) of letter to Member of Congress
- Completion of **Reproducible #3 – Food vs. Fuel Debate Rubric**

LESSON BACKGROUND

Relevant Vocabulary:

- **Distill:** to let fall, exude, or precipitate in drops or in a wet mist.[279]
- **Enzyme:** Any of numerous complex proteins that are produced by living cells and catalyze specific biochemical reactions at body temperatures.[280]
- **Ethanol:** A colorless volatile flammable liquid C_2H_5OH that is the intoxicating agent in liquors and is also used as a solvent and in fuel.[281]
- **Glucoamylase:** An enzyme that breaks the bonds near the ends of large carbohydrates (starches), releasing maltose and free glucose.[282]
- **Yeast:** a yellowish surface froth or sediment that occurs especially in saccharine liquids (as fruit juices) in which it promotes alcoholic fermentation, consists largely of cells of a fungus (as the saccharomyces, *Saccharomyces cerevisiae*), and is used especially in the making of alcoholic liquors and as a leaven in baking.[283]

Background Information:

The search for a viable alternative to fossil fuels has been fraught with difficulty. In the United States of America, society is so dependent on fossil fuels to run cars and factories that we lose sight of the amount of harmful byproducts that are pumped into the air every day. It is increasingly understood that finding an alternative way to run industry and transportation is of the utmost importance. Suggestions have been made and many of them, such as solar power, hydrogen power and ethanol, have been incorporated into transportation and industry on a small scale. However, each of these sources has failed to gain widespread use because of the objections that erupt from a variety of special interest groups. This issue is particularly evident in the case of ethanol.

Ethanol is a fuel made from plant products. It is considered a renewable energy source because it depends upon the growth of a plant which, at the most basic level, only needs sunlight, soil and water to grow. Ethanol can be made from an enormous variety of plant

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[279] "Distill Entry." *Merriam-Webster Online Dictionary.* Retrieved June 13, 2011 from http://www.merriam-webster.com/dictionary/distill

[280] "Enzyme Entry." *Merriam-Webster Online Dictionary.* Retrieved June 13, 2011 from http://www.merriam-webster.com/dictionary/high%20fructose%20corn%20syrup?ref=dictionary&word=enzyme#

[281] "Ethanol Entry." *Merriam-Webster Online Dictionary.* Retrieved June 13, 2011 from http://www.merriam-webster.com/dictionary/ethanol?show=0&t=1307986366

[282] "Glucoamylase Entry." *The Enzyme Experts.* Retrieved June 13, 2011 from http://www.enzymeexperts.com/index.php?option=com_glossary&func=display&letter=G&Itemid=26&catid=13&page=1

[283] "Yeast Entry." *Merriam-Webster Online Dictionary.* Retrieved June 13, 2011 from http://www.merriam-webster.com/dictionary/yeast?show=0&t=1307987172

life, usually feedstock, such as switch grass, cane sugar and sugar beet, among others. In the United States, ethanol fuel is most often made from corn. The corn is harvested, ground, and taken to a site where it can be chemically converted to ethanol alcohol by a process of heating and cooling. Gasoline is then added to ethanol liquid to make a blend of either 10% ethanol (which can be used in any car made after 1980 to improve performance and slightly decrease the amount of greenhouse gases emitted from the burning of the gasoline) or a higher concentration such as 85% which can be used only in cars specially fitted to run on ethanol.[284]

Making ethanol from corn becomes a highly contested issue when you consider corn as a popular food crop as well as the basis for fuel. Corn is a staple of the American diet and channeling large amounts of this crop into fuel would affect a high percentage of the foods that we eat everyday. Global debates over corn as food versus corn as fuel have opened up over the past decade as the use of ethanol has grown and continues to do so. Domestically, people in support of using ethanol fuel say that it is an excellent fuel source because it burns cleaner than gasoline and would help reduce the U.S.'s dependence on foreign oil. They are also optimistic that it will provide more domestic jobs because it will open up a new sustainable market to corn farmers. This type of fuel offers stability because, unlike fossil fuels, it will never run out as long as the sun shines and farmers can irrigate their fields.

On the other hand, opponents of this energy source say that as long as global hunger is such a significant issue, the United States should not divert food that could be used to feed the hungry to power our vehicles, and thus our consumerist lifestyle. They also fear that the use of corn for fuel would drive up the price of corn for food, thus making it more difficult for lower and middle class Americans to afford to feed their families. Others claim that ethanol would not really diminish our reliance on fossil fuels at all because it takes a lot of fossil fuels to produce and transport ethanol.

Many arguments exist on all sides of this issue. In June 2011, the Senate showed where it stood on this debate by voting down a measure that would have eliminated federal subsidies for ethanol made from corn, but Capitol Hill has not heard the last of ethanol.[285] It is clear that this debate will not be settled easily. This lesson will help students examine the facts behind this issue and understand that there is no right or wrong answer. Students will be guided towards forming an intelligent opinion, but will realize that this is a very complex issue that will not be solved over night.

Resources:

- **Fuel Economy of Ethanol** –*U.S. Department of Energy*: http://www.fueleconomy.gov/feg/ethanol.shtml

[284] "How Ethanol is Made." *Ethanol Promotion and Information Council, Inc.* Retrieved June 14, 2011 from http://www.youtube.com/watch?v=59R-NqykoXs
[285] "United States Senate Votes Down Ethanol Subsidies." *Humanitarian News*. Retrieved June 18, 2011 from http://www.humanitariannews.org/20110617/us-senate-votes-down-ethanol-subsidies-afp

- **Interactive Tour of Ethanol Plant** -*American Coalition of Ethanol:* http://www.ethanol.org/index.php?id=73
- **Pros and Cons of Various Alternative Fuel Sources**- *CNN Money*: http://money.cnn.com/galleries/2008/fortune/0804/gallery.green_biofuels.fortune/index.html
- **Corn Farmer Political Support Information-** *Corn Farmers' Coalition*: http://www.cornfarmerscoalition.org/
- **Common Uses of Corn-** *Ontario Corn Producers*: http://www.ontariocorn.org/classroom/products.html

LESSON STEPS

Warm-up: *What can Corn do?*

8. Begin this lesson by passing out **Reproducible #1 – Where is Corn Hiding?** Allow students five minutes to mark which items on the list they think contain corn or corn products.
9. After everyone has finished, tell the class that in fact *every* item on the list contains corn in a variety of different forms (high fructose corn syrup, corn meal, corn starch, etc.). Lead a discussion about the activity. Which items were the students surprised contained corn? *Answers will vary.* Why do they think that corn is such an important crop in the lives of Americans? *Subsidies, lots of land well suited to grow it, is extremely versatile and can be used to support many other industries such as growing livestock, etc.*
10. Ask students if they think using corn in the majority of the foods the American public eats is a bad thing. Why or why not? *It is not very healthy, makes the country wholly reliant on a single crop, makes junk food cheaper than healthy food because of corn subsidies, etc.*
11. Next, ask the class what they know about ethanol as an alternative fuel source. Make a list on the board of facts the students come up with. Once students have answered, fill in the gaps by explaining that ethanol is a liquid fuel that can be made from a variety of plant sources such as corn, sugar cane, switch grass and many others. Explain that ethanol is considered a renewable energy source because it relies on plant matter which needs only soil, sun and water to grow. In the United States, ethanol is usually made from corn; the very same corn that was used to make all of the items on the list.
12. Present the first three minutes of the video "How Ethanol is Made"[286] by the American Coalition for Ethanol.
13. Allow time for questions about the video.
14. Explain that the issue of using corn for food versus corn for fuel is a much contested

[286] "How Ethanol is Made." *Ethanol Promotion and Information Council, Inc.* Retrieved June 14, 2011 from http://www.youtube.com/watch?v=59R-NqykoXs

question in American politics and that there are many arguments in the debate. Ask students what their initial thoughts are about using corn for fuel versus corn for food. Do they think one use is more important than the other?

Activity One: *Food vs. Fuel Debate*

16. Now that students have a basic understanding of what ethanol is and why it is a difficult and multi-faceted issue, they have the right tools to begin to delve deeper into the debate. Inform students that the following day they will all be participating in a class debate about the issue of using corn as a food or fuel source. However, they will not be playing themselves, but rather one of a group of societal actors to whom this issue is very important.
17. Ask students what types of groups they think have a vested interest in the ethanol debate and why. Keep a list on the board of all suggestions. Once students are stumped, add any missing actors from the list below and explain what their interest is in this debate.
18. Next, tell students that they will be each assigned to play one of these characters in the debate. They will have to figure out the point of view their character would take on this matter and why. They will also need to do research so they can support their claims accurately. A breakdown of the characters is below; the teacher may also add characters that students brainstormed previously.
19. Assign each student a role to play in the debate. The roles are as follows:
    - Members of Congress (3-5 students)
    - Government Officials (1-3 students)
    - Small corn farm owner (1-3 students)
    - Large agriculture industry supported farmer (1-3 students)
    - Agriculture industry spokesperson (1-3 students)
    - Pig farmer (1-3 students)
    - Scientist (1-3 students)
    - Middle class American parent (1-3 students)
    - World Hunger Activist (1-3 students)
    - Environmentalist (1-3 students)

    Depending on the size of the class, each role may have a different number of students as listed above but make sure each role has at least one student. If the class is very small, the teacher can play the role of Congress to ensure that there are enough students to fill all the other roles.
20. Give each student a copy of **Reproducible #2 – Food vs. Fuel Debate Roles** to help them begin an investigation into their characters.
21. Tell the students that for the remainder of the class period and for homework that evening they must prepare to play their assigned roles in the debate the following day. Tell them that "Congress" is currently debating a piece of legislation that would outlaw using corn to make ethanol. Congress has requested the presence of each character to help make the decision leading up to a vote at the end of the day. Students assigned the same character will have to work together to develop a cohesive argument and each group will be given five minutes to explain their position before Congress. After a single student or group

of students presents their argument, Members of Congress will have one minute to ask the questions they prepared beforehand. Tell students that the objective of the debate it to convince Congress to vote in their favor. Students should be as persuasive as possible by using important facts and information. Encourage students to play their parts as though they were real people (including real-life examples, props and costumes). Remind students that if they are in a group of two or more students, they should distribute the work equally and each student should have a turn to speak during the presentation.

22. Give each student a copy of **Reproducible #3 – Corn: Food or Fuel Debate Rubric** to outline all of the requirements for the lesson. Explain that they will have to turn the rubric in at the end of the activity with the self-assessment column filled in.
23. Allow students the remainder of the class to begin research with books and Internet sources including those suggested on **Reproducible #2 – Food vs. Fuel Debate Roles**. Students playing actors should research their particular character's position, while students playing Members of Congress should brainstorm pertinent questions to ask each actor after their presentation.
24. Next class period, arrange the classroom so that the Members of Congress are sitting at the front and there is a space for characters to speak to Congress and the rest of the class.
25. Introduce the debate by reminding students that Congress is due to vote on a bill that would outlaw using corn to make ethanol. Congress has asked many different groups to explain their position on this issue. At the end of the debate, Congress will use the information it learns from each group to make its final decision. Each group has five minutes to speak and must answer Congress's questions for one minute afterwards.
26. Use a stopwatch to accurately time each presentation and question session directly following. Allow five minutes for each presentation and one minute for questions from the Members of Congress. Depending on the length of the class, presentations might extend into the next day.
27. After each character has presented, tell the class that now that Congress has listened to all the evidence, it is time for them make their final decision. Allow Congress five minutes to discuss their decision among themselves. After a conclusion has been drawn, Congress should make a short presentation to the class stating its decision and briefly why it was chosen.
28. For homework, students should write a short letter (2-3 pages) to their real Member of Congress about where the student personally stands on this issue. The letter should be in a formal letter format, and include scholarly information with proper citations. Remind students that this letter does not necessarily have to reflect the viewpoint of their assigned actor, but rather their personal ideas after listening to each presentation in the class Congress session. Explain that letters to a real Member of Congress really can have a big effect on that Member's political decisions and thus the letter should be taken seriously and executed professionally. After all students have turned in their letters, send them to the local Member of Congress.
29. *Optional: Have students present their letters for the class on the day they are

due.

30. Have students fill out the self assessment portion of **Reproducible #3 – Corn: Food or Fuel Debate Rubric** and hand in along with their letters.

Wrap Up: ***Review the Pros and Cons***

1. Make a class list of the pros and cons of using corn as a fuel source. Allow students to contribute as many ideas as possible. Keep a list of all ideas on the board. *Pros include cleaner and more sustainable than fossil fuels, larger market for corn farmers, renewable, etc. Cons include creates higher food prices, uses fossil fuels in production and transportation, creates less energy than normal gasoline, etc.*
2. Next, ask the class to make a list of the pros and cons of using corn as a food source. Keep a list of all ideas on the board. *Pros include easy and cheap to grow, plentiful amount of land on which to farm it, can be used in a large variety of products, is a native species, etc. Cons include its use as a variety of unhealthy sweeteners (such as high fructose corn syrup), extreme dependence on a single crop, etc.*
3. Ask students if they think it is possible to ever settle this debate in a fashion that would satisfy everyone? Why? Do they have any ideas for a compromise that could allow corn to be used as both food and fuel in an equitable way?

Extension: ***Are There Other Options?***

1. Have students research other forms of alternative energy (such as hydrogen, solar, etc.) and compare and contrast it with ethanol. Which is a more viable option? Why?
2. Assign students to keep a journal of the food they eat for three days. After they eat each item, have them check the ingredient list to see if corn or a corn product is included. Give them a list of tricky ingredient names that are likely to mean the item contains corn (such as hominy, masa, maltodextrins, sorbitol, vinegar, dextrose, food starch, vegetable starch, baking powder, maize, dextrin, vegetable gum, modified gum starch, and vegetable protein.) How much of what they eat is made from corn? Does this change their opinion on the debate?
3. Research and create a presentation on a city that uses an alternative energy source to power some part of its infrastructure (such as a public transportation system). Suggested cities include Rio de Janeiro, Brazil; one of the solar cities in Australia; etc. What part of these systems has been successful? What, if any, problems have arisen? How could the system be improved? Does it seem possible to create a similar system in the United States?

CONCLUSION

In this lesson, students examined the process of turning corn into ethanol fuel. They also explored the contentious issue of the food vs. fuel debate. By researching this topic, students took part in a current political issue to help deepen their knowledge of government. Students critically analyzed this issue to develop strong and persuasive arguments that were presented to their peers. By the end of this lesson, students were encouraged to draw their own conclusions about this issue and present them in a letter of opinion to their Congressperson to engage their civic responsibility.

LESSON PLAN CREDITS

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Where is Corn Hiding?

Check each item that you believe contains corn.

_____Wonder bread

_____Rice Krispies

_____Ketchup

_____Oreos

_____Nyquil

_____Yogurt

_____Pickles

_____Ice Cream

_____Glue

_____Crayons

_____White Flour

_____Instant Coffee

_____Mayonnaise

_____Toothpaste

_____Paint

_____Antibiotics

_____Batteries

_____Fireworks

_____Peanut butter

_____Aspirin

_____Chalk

_____Rubber

_____Cake Mix

_____Envelopes

_____Vitamins

_____Sprite

Food Vs. Fuel Debate Roles

You are a **Member of Congress.** You are neutral on this issue. You must brainstorm questions to ask each actor in order to make an informed decision at the end of all the presentations.

Suggested Sources:

- http://greenliving.lovetoknow.com/Ethanol_Biofuel_Pros_and_Cons
- http://www.businessweek.com/magazine/content/07_06/b4020093.htm
- http://www.washingtonpost.com/wp-dyn/content/article/2007/12/11/AR2007121101834.html

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You are a **Government Official.** You want to do what is best for the country as a whole as well as what you think will get you reelected to office.

Suggested Sources:

- http://www.freerepublic.com/focus/f-news/2672972/posts
- http://www.foodsafetynews.com/2011/02/usda-fully-deregulates-ethanol-corn/
- http://www.usda.gov/wps/portal/usda/usdahome?navid=ENERGY

You are a **Small Corn Farm Owner.** You and your family work your small Iowa farm along with two hired farm hands. You sell your crop independently. Producing corn is your only means of income.

Suggested Sources:

- http://chemicallygreen.com/corn-ethanol-higher-food-prices/
- http://cornandsoybeandigest.com/energy/be-ready-another-food-vs-fuel-fight
- http://www.nytimes.com/2006/01/16/national/16ethanol.html
- http://www.ers.usda.gov/AmberWaves/April06/Features/Ethanol.htm

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You are a **World Hunger Activist.** You work for a non-profit committed to ending world hunger. You are disgusted by the excess in which your society lives when there are people all over the world dying of starvation.

Suggested Sources:

- http://www.theglobalist.com/storyid.aspx?StoryId=5518
- http://www.foreignaffairs.com/articles/62609/c-ford-runge-and-benjamin-senauer/how-biofuels-could-starve-the-poor
- http://cei.org/op-eds-and-articles/ethanols-adding-hunger-us

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You are a **Large Agriculture Industry Supported Farmer.** You used to sell your corn crop independently but last year decided to contract with an agricultural conglomerate that guarantees to buy your corn even if the market is flooded with your product that season. This way, you never have to worry about supporting your family even in a bad year.

Suggested Sources:

- http://cornandsoybeandigest.com/energy/be-ready-another-food-vs-fuel-fight
- http://www.iowacorn.org/index.cfm?nodeID=30321&audienceID=1&action=display&newsID=13074
- http://www.nytimes.com/2006/01/16/national/16ethanol.html
- http://www.ers.usda.gov/AmberWaves/April06/Features/Ethanol.htm

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You are an **Agriculture Industry Spokesperson.** Your company buys an enormous amount of grains from farmers all over the country and is in control of most small and medium sized corn farms. You don't care what the corn will be used for but like to sell it to the highest bidder.

Suggested Sources:

- http://www.iowacorn.org/index.cfm?nodeID=30321&audienceID=1&action=display&newsID=13074
- http://www.nytimes.com/2006/01/16/national/16ethanol.html
- http://www.ers.usda.gov/AmberWaves/April06/Features/Ethanol.htm

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You are a **Pig Farmer.** You buy corn to fatten your pigs as quickly as possible. Selling pork is your only source of income. It is hard to make a net profit when feed prices go up and you have a family to support.

Suggested Sources:

- http://chemicallygreen.com/inconvient-truth-about-ethanol/
- http://www.npr.org/2010/12/22/132082743/if-your-meat-prices-rise-you-can-blame-ethanol
- http://www.ers.usda.gov/AmberWaves/February08/Features/CornPrices.htm

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You are a **Scientist.** You are on the frontlines of developing new sustainable fuel sources. You want to find a fuel that will be the most efficient and easiest to create.

Suggested Sources:

- http://www1.eere.energy.gov/biomass/environmental.html
- http://www.usatoday.com/money/industries/environment/2007-05-05-ethanolenvironment_N.htm
- http://chimalaya.org/2011/05/17/earths-next-generation-the-pros-and-cons-of-renewable-energy-sources/

You are a **Middle Class American Parent.** You have three children, drive a mini van and work full time. You are always a little strapped for cash and need to pinch pennies when you can. However, the kids come before all else and you want to keep them healthy, happy and safe.

Suggested Sources:

- http://chemicallygreen.com/inconvient-truth-about-ethanol/
- http://theenergycollective.com/geoffrey-styles/54997/missing-food-vs-fuel-circuit-breaker
- http://www.consumeraffairs.com/news04/2006/08/cr_ethanol.html
- http://www.ethanolrfa.org/news/entry/ethanol-brings-good-news-for-consumers-this-memorial-day/

You are an **Environmentalist.** The environment is your first priority. You realize that burning fossil fuels will not work for much longer and are desperate to find a clean, sustainable energy alternative.

Suggested Sources:

- http://www1.eere.energy.gov/biomass/environmental.html
- http://www.usatoday.com/money/industries/environment/2007-05-05-ethanolenvironment_N.htm
- http://chimalaya.org/2011/05/17/earths-next-generation-the-pros-and-cons-of-renewable-energy-sources/

Name: _____

Date: _____

Corn: Food or Fuel Debate Rubric

Task	Student Assessment	Points Possible	Teacher Assessment
Preparation -Researched using books, journal articles and reliable Internet sites apart from those suggested on role sheet - Prepared costumes and visual aids -Shared research work equally among group members		15	
Debate -Fulfilled, but did not exceed, 5 minute time requirement for actors, one minute for Members of Congress -Played role in a realistic manner -Used researched information and real-life applications -Equally shared presentation time between all group members -Answered Congress questions effectively -Listened respectfully to other actors' presentations		30	
Letter -Fulfilled the 2-3 page requirement -Clearly stated student's position on debate -Supported argument with reliable sources and data -Cited at least 3 sources -Used format and vocabulary appropriate for a formal letter		30	
Presentation (If Applicable) -Completed presentation of proper length -Well rehearsed and professional with clear position stated -Used visual aids -Answered class questions effectively		20	
Self-Assessment -Completed self assessment		5	
Total		100	