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# Using Enviromnetal Science Education to Empower Urban Youth to Overcome Environmental Injustices and Become Engaged Eco-Citizens

Jack J. Kearns
jackjk@stanford.edu

USING ENVIROMNETAL SCIENCE EDUCATION TO EMPOWER URBAN YOUTH TO OVERCOME ENVIRONMENTAL INJUSTICES AND BECOME ENGAGED ECO-CITIZENS

by

Jack Joseph Kearns

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**Abstract**

Science education, especially the discipline of environmental science, carries the unique opportunity to engage and empower urban youth of diverse backgrounds. Environmental science education helps establish a connection between youth and the natural world and helps youth engage in community-based stewardship activities while fostering ecological citizenry. When educators adopt innovative pedagogical approaches, students are better positioned to participate and develop a sustained interest in science. Field-based education transforms science learning and improves youth's sense of place, self-confidence, and motivation. National and local case-studies of field-based learning programs demonstrate the powerful and transformative impact of using the Environment as a Integrated Context (EIC) as an educational framework. Connecting urban youth to nature has a profound effect on attitudes and behaviors, especially for "at-risk" children. This body of research argues that environmental science education offers the best opportunity for educators to: (1.) engage urban youth to a science discipline, with the goal of decreasing inequalities in science education, (2.) discover and connect students with the outside world through field-oriented projects, (3.) encourage students to support their communities through "eco-citizenry" projects, and (4.) provide a pathway of hope and healing for "at-risk" or troubled youth.

## 1.0 INTRODUCTION

Please study the photo of a youth mural project from the city of East Palo Alto.


**Figure 1**. "Envisioning Peace" mural created by East Palo Alto youth from the Mural Music & Arts Project. The mural was dedicated in 2009 and represents four areas of peace: international peace, national peace, regional peace and inner peace.

This mural depicts a positive outcome for a community struggling with poverty and all its associated issues. The scene not only represents the hopes and dreams of the youth represented by the paper airplane transforming into a dove, but also the harmonization between urban youth and Mother Earth. The mural is a perfect presentation of the interconnectedness between humans hoping to achieve social and environmental justice in a world that respects humans and the earth as sacred creations worthy of protection. Educators and scientists within their respective communities must recognize that restoring, protecting, and sustaining the earth's resources, ecological systems, and biodiversity is inextricably connected to the level of social justice within these communities. The following masters' thesis will support the idea that environmental education for urban youth will bring harmony for human and ecological communities through connection to the outside world. The hope of the author is to spark a renewed sense of optimism, clarity, and action for the reader to promote the dreams of the inspired youth who created such a powerful mural.

Proper stewardship and management of the earth's natural resources and ecological services is critical to sustaining our current and future life on the planet. We depend on elements such as biodiversity to provide us with necessities and ecological services such as nutrient cycling, pollination, and water purification (Bolund and Hunhammar 1999; Millennium Ecosystem Assessment 2005). Since humans are the designated caretakers of the earth, educators and scientists can work collaboratively to engage, empower, and inspire communities through environmental science education to cultivate a sense of environmental stewardship. Developing a sense of "eco-literacy'' and environmental responsibility for K-12 students and their teachers can be accomplished by promoting an understanding of basic environmental science principles. The health and stability of ecosystems around the world are a reflection of the health and stability of humankind. Earth's life support systems provide for human civilizations to thrive and grow, thus it is our moral and ethical obligation to educate our youth to become greater stewards of "Mother Earth" than the previous generation.

## 1.1 Urban Environmental Science Education

Since 80% of the United States population is urbanized (US Census 2010), it is critical to focus attention on educating our urban communities about environmental issues. Since our youth are inheriting our planet, they need to be our priority for education and empowerment. We will depend on the younger generation to properly care take and have stewardship over our natural resources, while promoting and protecting biodiversity to sustain earth's life-giving processes. Environmental education can instill a lifelong learning process that promotes an understanding of the natural world, its ecological processes, and relationships, and ultimately cultivate a concern for the Earth (UNESCO 1976, 1978).

Of the many science disciplines available to teach, the environmental sciences (i.e. earth science, ecology, geology, marine biology) offer unique opportunities for engaging urban youth. Environmental science education helps with developing a "sense of place" or "spirit of a place" (Kudryavtsev et al. 2012; Golley 1998), bonding with nature (Orr 1992), developing an understanding of the scientific, cultural, and historical value of the place in which they live (Plannic 2008, de Kadt 2006), and connecting local knowledge to larger regional and global environmental issues (Ruiz-Mallen et al. 2009). Environmental science education has also been shown to increase engagement and enthusiasm for learning while applying science to real world

situations (Christenson 2004; Dresner 2002; Ernst 2007; Lieberman and Hoody 1998). It has also been shown to help students perform at higher levels on standardized tests and classroom activities (Ernst 2007; Glenn 2007; Lieberman and Hoody 1998). Connecting urban youth to the natural world can have a profound affect on the attitudes and behaviors of children, especially for youth exposed to street gangs and violence, drugs and alcohol, prostitution and poverty. Connecting to nature and wildlife can be a source of hope and healing for children struggling with emotional, physical, and spiritual issues.

## 1.2 Urban Youth Empowerment and Engagement

Environmental science education also carries the unique opportunity to engage and empower urban youth of diverse backgrounds. This type of education has the enormous potential to establish a connection between youth and the natural world. The potential for engaging in community-based stewardship is enormous and fostering ecological citizenship within families can be a benefit as well. Environmental science projects initiated by youth can be used as a tool to build partnerships with community groups, governments, churches, and private sector businesses. My research seeks to show the methodologies of how environmental science education increases ecoliteracy and empowers urban youth to engage as eco-citizens across America.

## 1.3 Thesis/Hypothesis

The research argues that environmental science education offers the best opportunity for educators to: (1.) engage urban youth to a science discipline, with the goal of decreasing inequalities in science education, (2.) discover and connect with the outside world through field-oriented projects, (3.) encourage students to support their communities through "eco-citizenry" projects, and (4.) provide a pathway of hope and healing for "at-risk" or troubled youth.

# 2.0 METHODS

The information presented in this master's thesis project is the result of an extensive and thorough literature review of journal articles, books, periodicals, reports, websites, government documents, and databases relating to urban environmental education. Anecdotal information is presented on behalf of the author's personal experiences and observations in the field of urban

youth and education. Interviews with educators and community organizers are included to support the thesis and offer real-time evidence and perspectives in the field of environmental education for impoverished minority youth.

## 3.0 HISTORY OF SCIENCE LITERACY IN AMERICA

### 3.1 Historical Background of "Scientific Literacy" and "Science for All" pre-*Brown vs. Board of Education*

"*A wise man is strong; yea, a man of knowledge increaseth strength."* King James Bible, Proverbs 24:5.

"*The ideal of human service is the ultimate goal of scientific effort, to the end of equipping the intellect for a better and more perfect use of human reason."* Francis Bacon, 1620 (Dick 1955).

This quote from scientist Sir Francis Bacon reflects the early roots to promote scientific literacy. Bacon, often credited for the phrase "knowledge is power", argued for improving the human condition through advancements in science and science education. He recognized that selecting scientific subject matter should be chosen to benefit "the most for the welfare of man" (Dick 1955). When Thomas Jefferson was vice-president of the United States in 1798, he showed particular interest in examining how science was being taught in schools at all grade levels. He viewed the sciences as "keys to the treasures of nature" and asked DuPont de Nemours, a medical doctor and minister of agriculture in France, to evaluate science teaching in American schools to make recommendations for improvement (Hurd 2001). de Nemours found that teachers did not have textbooks that related science to practical matters and science instruction was not enhancing the progress of the country (de Nemours 1923). In response, the U.S. Congress denied funding for science curriculum which focused on social progress, arguing that the responsibility be placed upon local governments.

Herbert Spencer, a British philosopher and social scientist during the Victorian era, examined school science courses and their relationship to human welfare. He examined the worth of knowledge taught in science courses and their impact on society. In agreement with Bacon, Spencer believed that science instruction should have a bearing on people's lives. Spencer's analysis revealed that school science courses were offering subject matter that failed to improve

the welfare of humans. He also observed that students were becoming passive learners denied opportunities to engage in the learning process of seeking answers and instructors in a school setting (Spencer 1859).

In 1847, James Wilkinson, a member of the Royal College of Surgeons of London, presented a lecture entitled "Science for All", where he pleaded for the sharing of scientific knowledge and discovery with the public. Wilkinson was also critical of the teaching methodologies of science because it was not promoting human understanding and the usefulness of science, but rather fostering ignorance and lack of comprehension. Wilkinson declared that "the ends of man are the ends of science, and even of nature too, so far as nature can be presented to the human faculties" (Wilkinson 1847).

During the 1930s in United States, the Progressive Education Association explored science education by appointing a committee to address the educational needs of America's youth. After years of study and debate, the committee proposed a science curriculum that hoped to promote a progressive student-centered approach based on four aspects of basic living: (1.) personal living; (2.) immediate personal-social relationships; (3.) social-civic relationships; and (4.) economic relationships (Report of the Committee on the Function of Science in General Education 1937).

In the early 1930's, while the Progressive Education Association was debating education reform, Dr. Carter Godwin Woodson, a son of former slaves and famous African American historian published his 1933 landmark book titled, *The Mis-education of the Negro.* Carter became only the second African-American in United States history to gain a doctorate degree. In his classic expose, he describes the worthlessness of education offered to African American youth. His major claim was that African American youth were being culturally indoctrinated in American schools that resulting in feelings of inferiority. Below are two quotes from Carter's main thesis:

"*The mere imparting of information is not education. Above all things, the effort must result in making a man think and do for himself..."* Dr. Carter Godwin Woodson, *The Mis-education of the* Negro, pg. 5, 1933.

*"The same educational process which inspires and stimulates the oppressor with the thought that he is everything and has accomplished everything worthwhile, depresses and crushes at the*

*same time the spark of genius in the Negro by making him feel that his race does not amount to much and never will measure up to the standards of other people…"* Dr. Carter Godwin Woodson, *The Mis-education of the Negro,* pg. 5, 1933.

In 1945, there were pivotal reports issued to address science education. First, *General Education in a Free Society,* published by The Harvard Committee, addressed many aspects of education in America and sought to embrace general education that integrates broad elements of thought. The second, *Science: The Endless Frontier*, called for the establishment of the National Science Foundation (NSF) to emphasize the relationship of NSF to science education reform. It also established a connection between science education and the emergence of new and talented scientists and engineers. NSF's program focused more on developing science disciplines and science careers than on the utilization of scientific knowledge benefiting social progress and "science for all people" (Hurd 1998).

Although advancements and attention to science education were being addressed for America's general population, little attention was focused on equity issues relating to education until *Brown v. Board of Education* (1954) decision, in which the U.S. Supreme Court determined that public education's doctrine of "separate but equal" was unconstitutional. It also stated that maintaining segregated schools violated the equal protection clause of the 14th amendment. The decision reversed the accepted doctrine of "separate but equal" to "equal opportunity for all." Some have contended that this Supreme Court decision did not result in equal educational opportunities (Tate 2001; Moses and Cobb 2001; Bell 1987).

## 3.2 "Science for All" Since *Brown v. Board of Education*

President Dwight Eisenhower appointed a committee of scientists and engineers in 1959 to consider how the knowledge of science and engineering could "advance social and cultural life" (President's Science Advisory Committee 1959). This effort represented a step toward creating a civic element of scientific literacy and education (Hurd 1998). In 1958, Paul DeHart Hurd first used the term "scientific literacy" in his article Science Literacy: Its Meaning for American Schools. His work focused on discussing a future of science education that fosters a conceptual framework of scientific contributions to culture and practical applications (Hurd 1958).

History of separate schools and curriculums based on race can be traced back to the early1800's and was brought to a high court for the first time in 1850 when the Supreme Court of Massachusetts heard the case *Roberts v. City of Boston*. The plaintiff sought to integrate schools in order for Black students to have access to the same curriculums as Whites. The lawsuit was rejected by the court but The *Brown v. Board of Education* Supreme Court ruling of 1954 later determined that the separate school statute established by *Plessey v. Ferguson* was unconstitutional.

Since student tracking and school segregation programs furthered the educational divide in America, two cases emerged producing rulings that struck down the legitimacy of tracking in public schools. *Hobson v. Hansen* (1967) and *Moses v. Washington parish school Board* (1972) decisions were based on the two major factors: first, Black students were assigned to lower tracks at a greater rate than their White counterparts; and second, the lower track classes provided inferior learning opportunities in comparison to the normal academic track (Tate 2001).

Understanding historic educational challenges in America will help to understand some of the challenges that still plague American society today. The educational community (researchers, teachers, administrators, government officials, NGO's) still struggles to provide a quality education for minority populations and students with diverse cultural and ethnic backgrounds. Struggles and challenges in society and educational systems alike have given rise to a diverse amount of opinions and research about how and why the system is struggling. Barton (2003) and Freire (1971) as well as others argued that inequalities in our culture and society have brought about cultural, economic, religious, and educational oppression within the school systems.

Paulo Freire, a world-renowned educator and philosopher dedicated his life's work to solving educational and societal oppression. Freire's work is best known from his book *Pedagogy of the Oppressed* (1971), where he showed that education has the power to transform and liberate people from the bonds of poverty, therefore allowing them to progress in their way of life. Freire was born in northwestern Brazil, where his ideologies about poverty and education were formed in response to viewing and living under enormous social inequalities and widespread illiteracy. His quest was to empower teachers and students with educational experiences that would enable them to control their own lives. His writings exposed the extreme biases in education allowing for a state of oppression through the educational system.

## 4.0 SETTING THE STAGE FOR TEACHING SCIENCE FOR SOCIAL JUSTICE: SCIENCE EDUCATION IN URBAN SETTINGS

Early calls for scientific literacy focused on finding better ways to link the work of scientists with the needs of society, creating more "productive" citizens, and adopting science as a legitimate school subject (Barton 2003). Barton's (2003) research for science literacy includes "the deep and thoughtful acquisition of key concepts and ideas, habits of mind, attitudes toward science, and the scientific skills necessary for individuals to be effective members of a technologically and scientifically advanced democratic society (Barton 2003 p.25)." Angela Calabrese Barton, a leading researcher and educator in teaching science to underprivileged urban youth, makes the claim that science for all is both a moral and ethical responsibility, while others claim science education is a civil right (Tate 2001; Moses and Cobb 2001; Bell 1987).

Statistical analysis is the main tool that shows children, mostly Hispanic and African American, in low-income and high-poverty in urban settings are quantitatively behind their White counterparts. Standardized test scores and grades in the sciences are the main body of evidence indicating the disparity. It is appropriate to clarify definitions of key words used in the following paragraphs demonstrating educational, racial, and economic disparities across the United States and California. The next sections are dedicated to presenting recent educational data showing the achievement gap between Whites and monitory youth.

### 4.1 Definition of "Urban"and "Poverty" in America

The U.S. Census Bureau defines the term "urban" as urbanized areas (UAs) and urban clusters (UCs). UAs are areas that "consist of densely developed territory that contains 50,000 or more people," and UCs consist of "densely developed territory that has at least 2,500 people but fewer than 50,000" (US Census Bureau website). For statistical analysis, the U.S. Census Bureau uses "poverty thresholds" to define poverty status for Americans. Poverty thresholds are dollar amounts earned by households in a given year. To illustrate this definition, the recent 2014 dollar amounts indicating poverty thresholds are displayed in Table 1.

**Table 1. United States Department of Health and Human Services (HHS) figures for poverty in 2014. Source: http://aspe.hhs.gov/poverty/14poverty.cfm**

| Persons in Family Unit | 48 Contiguous States and D.C. | Alaska | Hawaii |
|---|---|---|---|
| 1 | $11,670 | $14,580 | $13,420 |
| 2 | $15,730 | $19,660 | $18,090 |
| 3 | $19,790 | $24,730 | $22,760 |
| 4 | $23,850 | $29,820 | $27,430 |
| 5 | $27,910 | $34,900 | $32,100 |
| 6 | $31,970 | $39,980 | $36,770 |
| 7 | $36,030 | $45,060 | $41,440 |
| 8 | $40,090 | $50,140 | $46,110 |
| Each additional person adds | $4,060 | $5,080 | $4,670 |

## 4.2 National Statistics of Minority Children in Poverty and Low-income Families

As of the last Census in 2010, seventy-one percent of the US population live in urban areas (UAs), and nine percent live in urban clusters (UCs); therefore, eighty percent of the US population lives within urban areas (US Census Bureau 2010). Each year, the U.S. Census Bureau conducts the American Community Survey (ACS), which is a nationwide survey that collects data on demographic, social, economic, and housing characteristics about the nation's population. The information gathered is used as a tool for decision-makers and communities to assess changes in any given area.

The ACS defines "poor families" as those families that live below the federal poverty level. In 2012, the federal poverty level for a family of four was $23,283. According to the American Community Survey in 2012, there were 72,170,218 children in the United States and 22% lived in poverty. The racial demographics are a significant factor in the total populations of impoverished youth. Black, Hispanic, and American Indian children were at least 21% more likely to reside in a poor family than White children (See Figure 2).

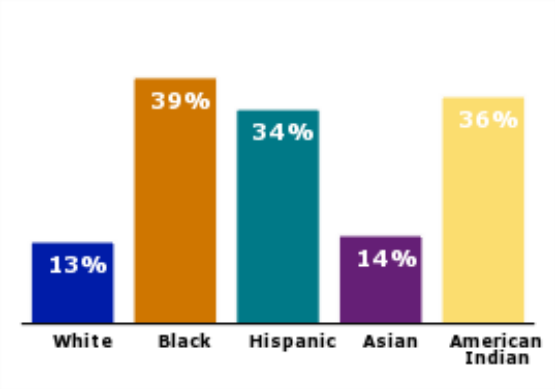



**Figure 2**. Children in Poor Families in the United States by race, 2012. Children living in families with incomes below the federal poverty threshold are referred to as poor. In 2012, the federal poverty level for a family of four was $23,283. (Source: http://www.nccp.org/profiles/state_profile.php?state=US&id=7)

Research suggests that families need an income of about twice the poverty level to satisfy the basic needs of life, and families below that amount are considered low-income ( (National Center for Children in Poverty). In 2012, that level was $44,700 for a family of four. In 2012, 45% of children lived in low-income families and race was once again a significant determinant for low-income populations. African American and Hispanic youth represented a disproportionate amount of total youth in low-income families (Figure 3).

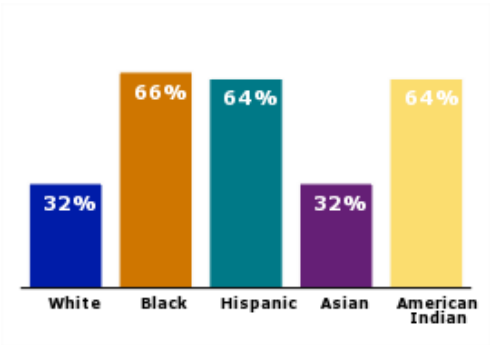



**Figure 3**. Children in Low-Income Families in the United States, by Race, 2012. Children living in families with incomes below $46,566 for a family of four in 2012 are referred to as low income. (Source: http://www.nccp.org/profiles/US_profile_6.html).

## 4.3 Trends in the National Drop-out Rate

Impoverished African American and Hispanic urban youth have the highest dropout rates in the United States (Fine 1991). Fortunately, dropout rates have steadily declined since 1972 for the all races. In 1972, the dropout percentages for the three races were White (12.3), Black (21.3), and

Hispanics (34.3). By 2011, the dropout rate sharply declined to Black (5.0), Black (7.3), and Hispanics (13.6) (U.S. Department of Commerce, Census Bureau, Current Population Survey (CPS), October, 1967 through 2011.). As depicted by the Figure 4, from 1990 to 2012, dropout rates have declined for Whites from nine to four percent, Blacks declined from thirteen to eight percent, and Hispanics declined from thirty-two to thirteen percent.

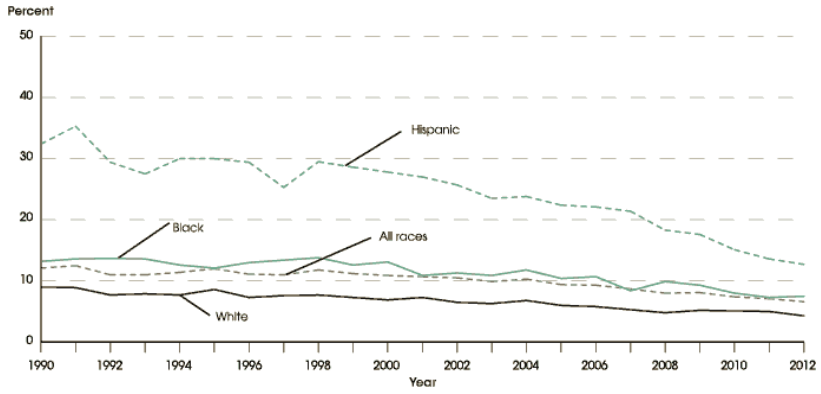



**Figure 4.** Status dropout rates of 16- through 24-year-olds, by race/ethnicity from 1990 through 2012.
NOTE: The "status dropout rate" represents the percentage of 16- through 24-year-olds who are not enrolled in school and have not earned a high school credential (either a diploma or an equivalency credential such as a General Educational Development [GED] certificate). Data are based on sample surveys of the civilian noninstitutionalized population, which excludes persons in prisons, persons in the military, and other persons not living in households. Data for all races include other racial/ethnic categories not separately shown. Race categories exclude persons of Hispanic ethnicity. (SOURCE: U.S. Department of Commerce, Census Bureau, Current Population Survey (CPS), October 1990 through 2012. See *Digest of Education Statistics 2013*, table 219.70.)

## 4.4 National science literacy for impoverished minorities

Within the U.S. Department of Education (USDOE), the National Center for Education Statistics conducts national and state assessments of academic achievement of elementary and secondary students. Since 1969, the congressionally mandated assessment project called the National Assessment of Educational Progress (NAEP) has continually monitored the academic achievement of students in the areas of reading, mathematics, science, writing, U.S. history, civics, geography, and other subjects. NAEP's reports or "The Nation's Report Card," is considered an integral part of the USDOE's efforts to evaluate the condition and progress of education. This research paper is only concerned with the results of science scores for racial groups most "at risk" for underachievement. The results used here are from a sample of eighth-graders that participated in the 2011 NAEP science assessment, which intended to evaluate student's knowledge and abilities in the areas of physical, life, space, and earth sciences.

Nationwide, the average science scores for eighth-graders by race was disproportionately lower for Black and Hispanics. Black students scored lower than White students by 34 points and Hispanic students scored lower by 26 points (Table 2). Statistical analysis from the National Center for Children in Poverty consistently show that the majority of poor children are Black and Hispanic across the nation, and according to NAEP results, a correlation exists between poverty and lower test scores.

**Table 2**. National percentage of students and average scores in eight-grade NAEP science, by race/ethnicity: 2011. Source: The Nation's Report Card: Science 2011.

| Race/ethnicity | Percentage of students | Average scale score |
|---|---|---|
| White | 55 | 163 |
| Black | 15 | 129 |
| Hispanic | 21 | 137 |
| Asian/Pacific Islander | 5 | 159 |
| Asian | 5 | 161 |
| Native Hawaiian/Other Pacific Islander | # | 139 |
| American Indian/Alaska Native | 1 | 141 |
| Two or more races | 2 | 156 |

# Rounds to zero.
NOTE: Black includes African American, Hispanic includes Latino, and Pacific Islander includes Native Hawaiian. Race categories exclude Hispanic origin. Detail may not sum to totals because of rounding.

NAEP determines poverty based on the students eligibility for the National School Lunch Program (NSLP). The guidelines of the NSLP state that children from families with incomes below 130 percent of the poverty level are eligible for free meals. Likewise, children from families with incomes between 130 and 185 percent of the poverty level qualify for reduced-price meals (Between July 1, 2010 and June 30, 2011, for a family of four, 130 percent of the poverty level was $28,665, and 185 percent was $40,793). NAEP statistics show 72% of eighth-graders scored below the 25$^{th}$ percentile qualified for the free or reduced-price lunch program, and 66% of those students were African American and Hispanic. Conversely, among eighth-graders that scored above the 75$^{th}$ percentile, 76% were White, 4% were Black, and 10% were Hispanic, while 21% were eligible for the free or reduced-price school lunch program.

## 4.5 Race and Poverty in America Today

The relationship between impoverished youth and poor academic success has been understood for many decades, but it is relevant to show an updated statistical body of data, and also illustrate that race is still a major predictor of children in poverty. Certain states in the Union demonstrate this point in a profound way. For instance, in the District of Columbia, 82% of the eighth-graders tested were Black students compared to 11% Hispanic and 5% White. Within the Black student population, only 19% scored at or above *Basic Proficiency*, compared to 87% of White and 30% of Hispanics (*The Nation's Report Card: Science 2011*). National data collected by the 2012 American Community Survey, indicated that 63% of Black children in the District of Columbia under the age of eighteen belong to a low-income family (National Center for Children in Poverty ).

Another stark example exists in the state of Mississippi where the percentage of Black and White students tested was nearly the same (49% and 47%). In these results, 72% of the White students tested at or above *Basic Proficiency* whereas 23% of Black students tested at the same level (*The Nation's Report Card: Science* 2011). In 2012, the ACS indicated that 36% of children in Mississippi lived in poor families and 54% of them were Black, 40% were Hispanic, and 20% were White (Figure 5). Children in low-income families (58%) was drastically higher and an overwhelming 77% were Black and 69% Hispanic juxtaposed to White children at 41% (Figure 6).

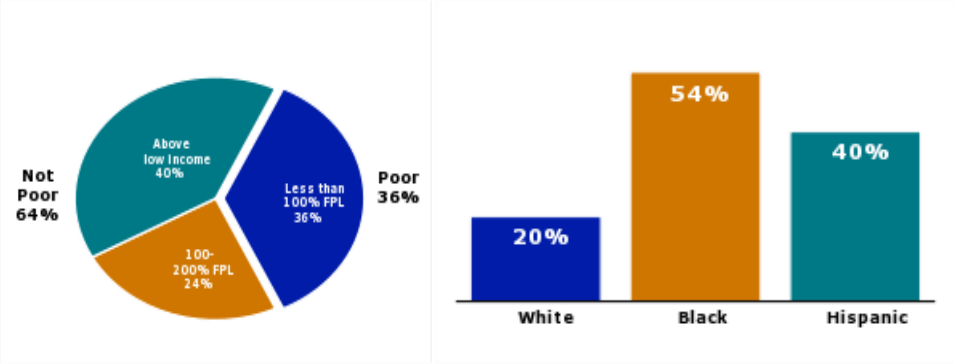



**Figure 5**. Percentage of poor children in Mississippi, and racial breakdown, 2012. Source: http://www.nccp.org/profiles/MS_profile_9.html

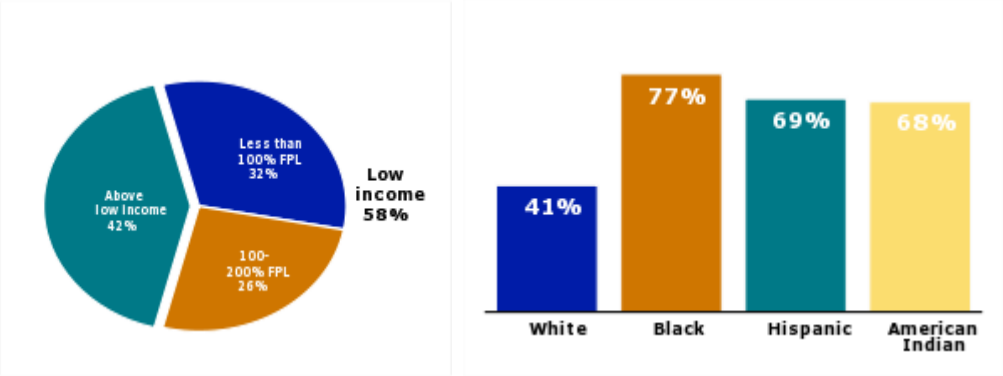



**Figure 6**. Percentage of children in Mississippi in low-income families and by race, 2012. (Source: http://www.nccp.org/profiles/state_profile.php?state=MS&id=6)

## 4.6 Science Literacy and Poverty in California and the San Francisco Bay Area Among Minority youth

California is of particular interest since it is the home state of the author and where research will be focused on throughout the paper. California is also of interest since the child poverty rate continues to rise even as the state's economy recovers from the Great Recession. By 2011, the child poverty rate in California was 24%, which was slightly higher than the nation's average poverty rate at 21.4% (Public Policy Institute of California). According to the American Community Survey (ACS) 2008 to 2012 population estimates, the total percentages of race in California were 65% White, 37% Hispanic, and 7% Black (U.S. Census Bureau, 2008-2012 American Community Survey). Statistics reflect that children in economic hardship in California have similar nationwide disparities between White, Black, and Hispanics. Although the total Black population in California is relatively low, the percentage of Black children living in poor and low-income families is considerably higher than Whites. The amount of Hispanic children in poor or low-income families is also considerably higher than Whites (Figures 7 and 8).

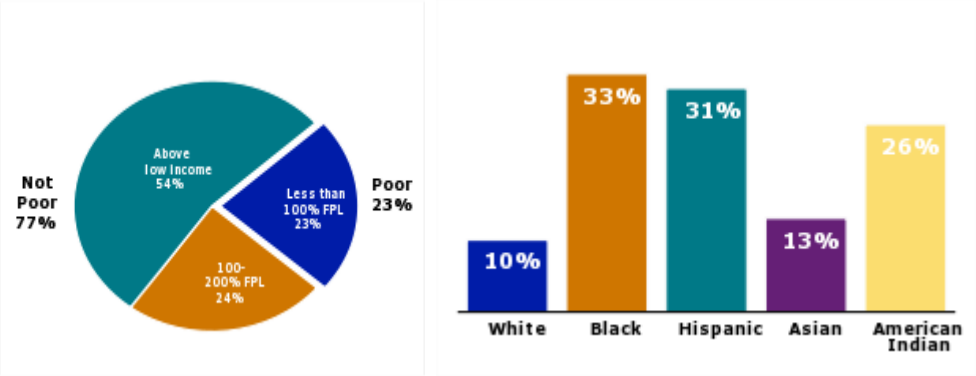



**Figure 7**. Children in poor families in California and percent of poor children by race, 2012. (Source: http://www.nccp.org/profiles/state_profile.php?state=CA&id=7)

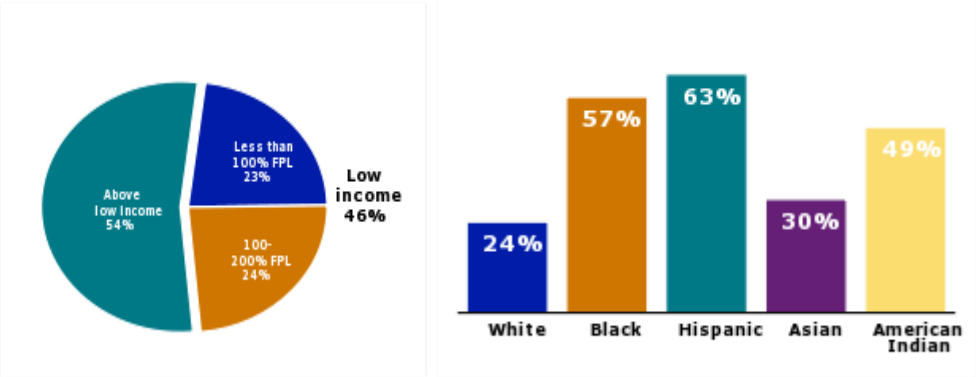


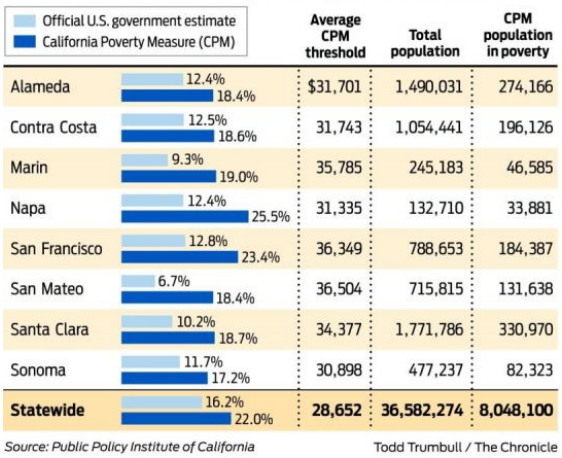

**Figure 8.** Children in low-income families in California and percent of children in low-income families by race, 2012. (Source: http://www.nccp.org/profiles/state_profile.php?state=CA&id=6)

Across California, the child poverty rate varies considerably while the eight counties in the San Francisco Bay Area (San Mateo, Marin, Santa Clara, Santa Cruz, San Francisco, Contra Costa, Alameda, and Sonoma) were actually lower than the rest of the state. The Bay Area counties are in the bottom quarter for child poverty rates statewide while the central valley counties (Fresno,Tulare, Merced, Kings, Kern, Madera, and Stanislaus) are the highest. Poor children in Los Angeles County was nearly 30%.

For a more accurate measurement of poverty in the Bay Area, researchers at the Public Policy Institute of California and Stanford Center on Poverty and Inequality assessed the poverty level with consideration to regional cost of living. Their estimates put the total population in poverty at 22% compared to the official government statistic of 16% Furthermore, their calculated child

poverty rate of 23% was higher than the government's number of 25% (A Portrait of Poverty within California Counties and Demographic Groups 2013). Table 3 shows the difference of poverty percentage among the eight Bay Area counties. The California Poverty Measure (CPM) reflects the adjustment for regional cost of living, while the opposing percentage is the government's measurement.

**Table 3**. Snapshot of the new California Poverty Measure (CPM) released in a report compiled by the Public Policy Institute of California in collaboration with the Stanford Center on Poverty




| | Official U.S. government estimate | California Poverty Measure (CPM) | Average CPM threshold | Total population | CPM population in poverty |
|---|---|---|---|---|---|
| Alameda | 12.4% | 18.4% | $31,701 | 1,490,031 | 274,166 |
| Contra Costa | 12.5% | 18.6% | 31,743 | 1,054,441 | 196,126 |
| Marin | 9.3% | 19.0% | 35,785 | 245,183 | 46,585 |
| Napa | 12.4% | 25.5% | 31,335 | 132,710 | 33,881 |
| San Francisco | 12.8% | 23.4% | 36,349 | 788,653 | 184,387 |
| San Mateo | 6.7% | 18.4% | 36,504 | 715,815 | 131,638 |
| Santa Clara | 10.2% | 18.7% | 34,377 | 1,771,786 | 330,970 |
| Sonoma | 11.7% | 17.2% | 30,898 | 477,237 | 82,323 |
| **Statewide** | 16.2% | 22.0% | **28,652** | **36,582,274** | **8,048,100** |

*Source: Public Policy Institute of California* Todd Trumbull / The Chronicle

Scientific literacy among eight-graders in California indicate similar disparities between racial and income groups. The chart below (Table 4) shows that Blacks had an average score that was 36 points lower than White students were, and Hispanic students had an average score that was 31 points lower than White students. With regard to economics, students who were eligible for the free or reduced-price lunch program had an average score that was 30 points lower than students who were not eligible.

**Table 4.** Results of science assessments for California eight-graders by race and income level (National school Lunch Program), 2011. (Source: U.S. Department of Education, Institute of Education Sciences, national Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2009 and 2011 Science Assessments.)

**Results for Student Groups in 2011**

| Reporting Groups | Percent of students | Avg. score | Percentages at or above *Basic* | *Proficient* | Percent at *Advanced* |
|---|---|---|---|---|---|
| Race/Ethnicity | | | | | |
| White | 26 | 159 | 74 | 39 | 2 |
| Black | 7 | 124 | 32 | 8 | # |
| Hispanic | 51 | 128 | 39 | 11 | # |
| Asian | 14 | 158 | 73 | 41 | 2 |
| American Indian/Alaska Native | 1 | ‡ | ‡ | ‡ | ‡ |
| Native Hawaiian/Pacific Islander | 1 | ‡ | ‡ | ‡ | ‡ |
| Two or more races | # | ‡ | ‡ | ‡ | ‡ |
| Gender | | | | | |
| Male | 51 | 143 | 55 | 25 | 1 |
| Female | 49 | 138 | 50 | 20 | 1 |
| National School Lunch Program | | | | | |
| Eligible | 55 | 127 | 37 | 10 | # |
| Not eligible | 44 | 157 | 71 | 38 | 2 |

Results from NAEP reports of average scores and achievement level for eighth-grade public school science tests indicate that California and Alabama ranked second lowest in the nation (NAEP 2011 Science Assessment). The average score of students in California was 140, while the average score for public school students in the nation was 150 (Figure 9). The average score for students in 2011 did not significantly improve from their previous score of 137 in 2009 (Figure 9). A staggering 47% of students in California were below *Basic Proficiency*, down from 52% in 2009 (Figure 10). The gap between the students at the 75$^{th}$ percentile and students at the 25$^{th}$ percentile was 50 points. Race and income level were major factors responsible for this achievement gap.

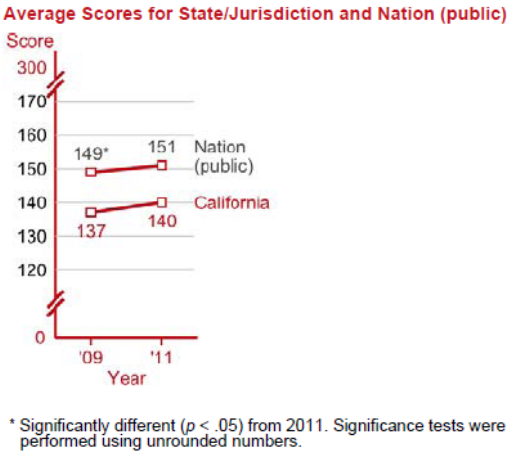



**Figure 9**. Average scores from 2009 and 2011 data for eigtht-grade science assessments. (Source: "The Nations Report Card," Science 2011 State Snapshot Report).

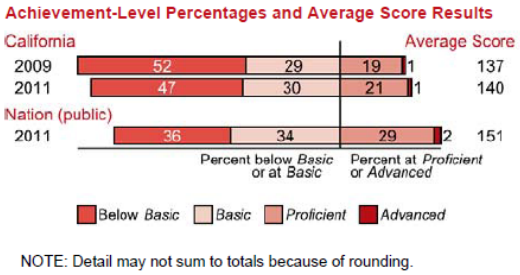



**Figure 10**. Achievement level percentages and average score results for California compared to the Nation. (Source: "The Nations Report Card," Science 2011 State Snapshot Report).

Since the San Francisco Bay Area is full of innovation and science technology with a growing urban population, it seems prudent to discuss some results from the Bay Area. In 2007, results from the 5th grade California Standards Test (CST) in Science indicated that approximately 46% of Bay Area students scored proficient or above (Dorph et al 2007). Even in the Bay Area, nearly half of 5th grade students are failing to reach proficiency in science. Once again, demographics play a key role in determining results, as the Black and Hispanic populations tested poorly. For instance, when comparing Menlo Park and East Palo Alto, two cities with drastically different demographics and socioeconomics, the results were clear. In 2009, the racial make-up in the Menlo Park City School District was 87% White, 7% Black, 11% Asian, and 6% Hispanic (American Community Survey 2009). Their 2012 CST results for science in the fifth grade was 71% advanced, 22% proficient, 5% basic, 1% below basic, and 1% far below basic. In East Palo Alto, the Ravenswood School District racial make-up is 78% Hispanic, 10% Black, and 10% Pacific Islander. Nearly 90% of students are considered low-income, 67% of students are English language learners, and 54% of parents are not high school graduates (Ravenswood Education Foundation). Their state test results in science for fifth graders was drastically lower at only 3% advanced, 22% proficient, 37% basic, 21% below basic, and 17% far below basic (California Department of Education 2012).

In response to the challenge of science education in the Bay Area, researchers at the UC Berkeley Lawrence Hall of Sciences surveyed teachers, districts and other data in an attempt to understand why students were not performing well. They conducted numerous interviews and surveys with seven County Offices of Education, nine-hundred and twenty-three elementary school teachers, four science support programs, and seventeen science education institutions within the participating school districts (60% of school districts responded, representing 70% of schools and students in the Bay Area). Their results yielded fascinating insights about challenges with science education. Their findings suggested that science education is inconsistent and often poor quality. For example, 80% of K-5$^{th}$ grade teachers reported spending 60 minutes or less per week on science, with 16% of teachers spending no time at all on science. On average, the survey results revealed that students were receiving 60 minutes of science instruction per week. According to a national survey in 2000, the national average was 125 minutes per week (Fulp 2002). Additionally, many multi-subject teachers felt less prepared to teach science than they do with other subjects. They also indicated that there were too few opportunities for professional development in the areas of preparation were unavailable. Many responses highlighted the current status of science education from a public policy standpoint was weak and does not adequately address the importance of science education (Dorph et al 2007).

Many challenges exist in the world of science education throughout the nation and especially in California. Cultural, socio-economic, and political concerns are just a few of the hurdles when attempting to properly educate our youth, especially minority youth (Black, Hispanic, Pacific Islander and Native American). The previous statistics demonstrates that the challenge of science education lies within communities with heavy populations of minority groups that struggle with poverty. Is there a science discipline that could bridge the gap? If so, could this science disciple affect the overall performance of the student? Could this education help to empower the urban minority student to become engaged and active in school, at home or even in the community? How or why will this education help to improve an individual's "sense of place" or help to heal individual or community troubles? This next section seeks to demonstrate the positive outcomes of environmental education for youth and states the importance of environmental and earth science concepts as they pertain to the natural world.

## 5.0 HISTORY OF AMERICAN ENVIRONMENTAL THOUGHT AND GENESIS OF "ECOLOGICAL CONSCIOUSNESS"

*"And it shall come to pass, when I bring a cloud over the earth, that the rainbow shall be seen in the cloud : … And the rainbow shall be in the cloud; and I will look upon it, that I may remember the everlasting covenant between God and every living creature of all flesh that is upon the earth."* King James Bible. Genesis 9:14-16.

*"In all things of nature there is something of the marvelous."* – Aristotle (Book 1, 645.a16).

### 5.1 Influence of American Environmental Thought on the Environmental Education Movement

These verses and quotes strongly articulate the connection to planet earth and its outside environment. Connection to ecosystems and their services, reliance on natural resources and global cycles allow humans to exist on the planet. Our connection to the outside world is intrinsic to the fabric of life and our existence. This basic connection and understanding has formed the basis for research suggesting that environmental education has a profound and positive impact on the academic and emotional well-being of young students from kindergarten through twelfth grades. Furthermore, this research aims to strengthen and support the idea that environmental education can transform the educational experience of many impoverished youth across the country. Public school districts that struggle with achievement gaps, high dropout rates, and widespread poverty can accomplish their goals through meaningful engagement in environmental education, especially when applied to earth related sciences.

To better understand the roots and history of environmental education, we must first look at the formation of environmental thought and the genesis of the "ecological conscience" in American society. Early environmental influences in America were rooted in diverse forms of thought, often related to the spiritual or sacred connection between nature and humans. Many prominent Native American tribal leaders spoke about the relationship between the earth and human life. Chief Si'ahl or Chief Seattle, of the Duwamish tribe spoke about the interconnection between human and earth life when he said:

*"…All things are connected, like the blood which unites one family. All things are connected. Whatever befalls the earth, befalls the sons and daughters of the earth. We did not weave the web of life; We are merely a strand in it. Whatever we do to the web, we do to ourselves…"* (Earth Prayers From Around the World 1991).

Many American Indian cultures view the Earth as the "sustainer" and "giver" of life. Their creation stories, rituals, ceremonies, and acts of healing centered on the idea of "Mother Earth" or "Great Spirit" to invoke reverence and sacred respect for the giver of air, water, soil, and animals to sustain life. Contemporary Indian writer Ed McGaa or Eagle Man is a member of the Oglala Lakota Sioux tribe, flew as a Marine fighter pilot (decorated with numerous military honors), and graduated from University of South Dakota with a law degree. He has authored many books about "Mother Earth Spirituality". He stated the relationship between human healing and Mother Earth:

*"Let us think of Mother Earth, her rich bounty that will result from springtime, the golden corn and the seeds of harvest, all grown strong from Mother Earth, the spring rains, and the energy of Father Sky. It is time to consider healing: healing of ourselves, healing of a loved one, healing of adversaries for peace among nations, and healing of the harms done to Mother Earth."* (Earth Prayers From Around the World 2001).

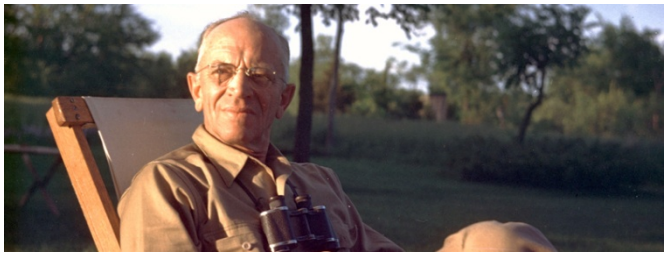
Early transcendentalist Henry David Thoreau and poets such as Walt Whitman and Emily Dickenson wrote about the importance of human connection to nature, especially as they witnessed wilderness areas being transformed to urban city centers to support growing human populations. They helped Americans transcend the ideology of nature and wilderness areas (including plants and animals) needing to be conquered by man and urbanization. Contemporary influential thinkers like John Muir, Aldo Leopold, and Rachel Carson helped remind the growing American society of the constant responsibility to maintain proper stewardship of America's open spaces, to limit our destruction of nature, and to raise our consciousness about environmental pollution. John Muir was devoted to rescuing and protecting American wilderness and once said in 1895, that:

*"...I have not lagged behind in the work of exploring our grand wilderness, and in calling everybody to come and enjoy the thousand blessings they have to offer."*

(Wilderness and the American Mind 1982).

John Muir was considered by many to be an early prophet of the "out-of-door gospel" (American Review of Reviews 1912), and he staunchly discredited the idea that Christianity and the Bible were in disharmony with eco-centric views. After discovering and discerning the truth that sciences and the natural world complemented rather than conflicted with worship and religion, he wrote to a professor in 1866 that the Bible and nature were, "two books which harmonize beautifully" (Wilderness and the American Mind 1982).

Another American "prophet" of the outdoors was Aldo Leopold (Figures 11 & 12), who was a highly educated and achieved forester, author, and conservationist. He is credited with the development of modern environmental ethics and he helped further the concepts of "ecological conscience" or "ecocentrism". Leopold had a profound impact on the environmental movement and his "eco-centric" views toward preservation emphasized biodiversity and ecological principles. Leopold created new developments in the science of ecology, and would later advance these principles in the fields of forestry and game management. Ecology allowed him to view nature as an intricate web of interconnected biotic and abiotic components functioning together to form ecosystems.




**Figures 11 and 12**. Aldo Leopold (1887-1948), renowned forester, author, and conservationist. (Source: aldoleopold.org)

Leopold asserted that developing an ecological conscience allows the individual an opportunity for a higher ethical attitude toward nature. Summarizing his ideas, he states that this "changes the role of *Homo sapiens* from conqueror of the land-community to plain member and citizen of it. It

implies respect for his fellow-members, and also respect for the community as such" (Sand County Almanac 1949). Shortly after his death, Paul Errington wrote and published an article honoring Leopold's work dedicated to the field of wildlife management. In the introduction, Errington beautifully articulated his thoughts about Leopold when stating, "…we need only consider the strategic positions that he held, the astounding amount of work that he did on committees, the insight and diligence with which he pioneered in the field, his honesty of purpose, and his inspiring and leading of youngsters and the mature alike" (Errington 1948).

Rachel Carson encouraged us face the devastating impacts of human environmental pollution with her iconoclastic book "Silent Spring" published in 1969. In her groundbreaking expose, she exposed to the nation how harming the environment would disrupt food chains and ultimately cause ecological collapse for wildlife populations and human communities. Her influence on ecological consciousness and the environmental movement cannot be understated. Carson's book contributed significantly to heightening the concern for the environment and ecological stewardship. Highly visible signs of environmental deterioration such as major oil spills and flammable rivers, and less visible problems such as the symptoms of widespread chemical exposure culminated in bringing about a revolutionary environmental movement in America. In response, a strong desire increased for more environmental education around the nation and the world.

Early thinkers and scientists were tremendously influential on the environmental movement, and they all advanced the recognition that environmental education can have an enormous impact on individuals and communities. Attempts to bring environment-based education to youth are based on the principal of renewing a sense of connection and familiarity with the outside world within their own communities. After World War I, popular nature writer and aesthetician, John C. Van Dyke articulated a timeless sentiment in his questions:

*"Was there ever a time in human history when a return to Nature was so much needed as just now? How shall the nations be rebuilded, the lost faith and hope renewed, the race live again save through the Great Mother whom we have forsaken? She lays the warp and binds the woof and speeds the splendor of the world, let man do what he may to mar her work. How shall we live without her?"* (Van Dyke 1920).

These important questions still hold considerable value today. Environmental education seeks to restore the balance and appreciation of nature once echoed by our nation's First Peoples. These individuals and more have had a profound impact on the societal view of nature and the environment. They have all contributed to a greater environmental ethic and regard for the natural world. Their thoughts, actions, and life's work will continue to influence our decisions and attitudes today and for many generations to come. In 1944, Aldo Leopold is quoted as saying, **"**Acts of conservation without the requisite desires and skill are futile. To create these desires and skills, and the community motive, is the task of education." This quote blends itself beautifully with the next section which describes the history, formation, definitions, and benefits of environmental education.

## 6.0 JUSTIFICATION OF "NATURE STUDY" AND THE HISTORY OF ENVIRONMENTAL EDUCATION

### 6.1 Human Relationship to the Natural World

Why undergo such a massive effort to implement environment-based education, especially in urban communities struggling to close the achievement gap and better educate minority youth? Throughout history the human connection to nature has been defined by dependency on natural resources to grow food, raise or kill animals to eat, use vegetation and stone to build homes or shelters, and use water for irrigation to sustain life. Since the beginning of time, before formal education was instituted, humans taught their children to survive in nature by using nature's resources or how to live sustainably within their environment. Children learned about their environment naturally through work and play alongside family members. As in the animal kingdom, human children would watch their parents hunt, fish, make tools, start fires, build shelters, and prepare food. With the emergence of agriculture in human societies, children observed and were taught how to plow, plant, and irrigate their crops. These experiences contributed to the knowledge about interrelationships, connections, and interdependencies between themselves, their families, and the natural world. However, when the industrial revolution began many societies focused on conquering nature and becoming more civilized and less tribal and agrarian. Human populations exploded leading to urbanization and creation of

large cities, while wilderness areas such as forests, wetlands, deserts, and prairie grasslands were destroyed.

Over millions of years, human tools, skills, and knowledge increased leading to an increasing population continuing to alter the environment. Earth's human population continues to grow exponentially, going from 450 million people in 1500, to 1.6 billion in 1900, and 7.1 billion in 2010. With this massive increase in human population, environmental impacts have led to adverse impacts on air and water pollution, overconsumption of natural resources (energy, food, water), global climate change, loss of biodiversity (including extinctions), and ocean degradation. Scientists have even calculated that the weight of the planet has shifted altering the Earth's orbit as a result of damming major rivers worldwide (Chao 1995).

Over time, archaeologists have shown the wide variety of ways humans have transferred knowledge and skills to children. European caves show children worked alongside adults recording knowledge about animals and plants. These and other pictographs were a record of the education that children received and how they depended on the natural world for survival. In ancient civilizations of Mesopotamia, findings reveal that people began to record on clay tablets, followed by ancient Egyptian development of hieroglyphics, displaying a more complex writing system (Lieberman 2013). Tablets became scrolls, scrolls became books, and books have now retuned to tablets in the computerized form.

## 6.2 Disappearance of Outdoor Activity and the "Nature-Deficit Disorder"

During the last 150 years, the four walls of a classroom have formed a gap between children and their environment limiting their educational experiences to the indoors. Increasingly, children spend less time exploring outdoor features such as ponds, woods, and fields, while they prefer interacting with television, computers, and video games. Schoolwork with textbooks, workbooks, computers, and video games replace learning opportunities like field trips, and hands-on activities like planting gardens, studying wildlife and raising butterflies (Louv 2008). School field trips to parks, forests, ponds, beaches, or even farms and zoos have historically represented the only contact with the natural world for urban children, and unfortunately these outings have been eliminated or reduced (McMurrer 2008; Ellerson 2012).

Since passage of the *No Child Left Behind Act* in 2001, state governments and local school boards struggle to meet rigorous testing standards by removing physical education classes and reducing recess time. The National Parent Teacher Association (PTA) reported that nearly 40% of American elementary schools eliminated or are considering eliminating recess while the federal government reported that only 36% of children receive the recommended amount of physical activity (Federal Interagency Forum on Child and Family Statistics 2007). *Sports Illustrated* columnist Steve Rushin made a poignant comment when he said in an article, "Lifers at Leavenworth get more time in the exercise yard." Sadly, this may prove to be true by the following comments made during research with students and teachers across the nation. Richard Louv wrote about the new realities of family life in America titled *Childhood's Future*, where he interviewed nearly three thousand children and parents. A fourth grade child from San Diego remarked, "I like to play indoors better,' cause that's where all the electrical outlets are" (Louv 2008). Lieberman (2013) conducted similar interviews about the environment with teachers' and students and a teacher from Ohio commented, "But we don't have an environment at our school." Journalist and researcher Ricahrd Louv in his book, "*Last Child in the Woods: Saving Our Children From the Nature-Deficit Disorder*," contends that human alienation from nature leads to a phenomenon he calls *nature-deficit disorder* (Louv 2005). He highlights research showing a disconnection with nature and the outdoor environment can lead to a disorder that causes a diminished use of the senses, attention difficulties, and higher rates of physical and emotional disorders. Nature deficit can also lead to communities with higher crime rates, depression, and other maladies, especially those communities with an absence of parks and open spaces.

On a positive note, schools and communities across the nation are embracing nature and many positive outcomes of environmental science education for youth are surfacing. Fourth graders in Georgia have learned how to protect tree frogs through the legislative process; sixth-graders in Pennsylvania have cleaned a polluted creek while learning civic responsibility, eighth-grade students in Massachusetts have analyzed data about sewage discharges into Buzzards Bay to determine compliance with federal standards, and California high school students are working to

reduce their schools waste production (Lieberman 2013). Detailed evidence and further success stories about the benefits of environmental education will be discussed in a later section.

## 6.3 History of "Nature Study" and the Environmental Education Movement

Efforts to learn and record the natural world started with Aristotle recognizing Thales of Miletus (620-546 BCE) as the founder of "natural philosophy", which preceded the formal discipline of science. Early studies in the field of biology focused on naming and describing living organisms and their behaviors. First-century observer and naturalist Pliny the Elder (27-79 CE) recorded his observations of the environment in thirty-seven volumes called *Natural History*. Carl Linnaeus, the renowned physician, botanist, and zoologist is responsible for developing the system of binomial nomenclature still used today for the purposed of naming and classifying living organisms. In the years to follow, scientists such as Charles Darwin, Alfred Russel Wallace, and John James Audubon would expand and elaborate on earlier observations and natural histories of living things. As discussed earlier, the new field of ecology would later follow in the nineteenth century, which emphasized ecosystem interactions and the interdependence of organisms within their environments.

With large school systems being developed to accommodate the growing urban populations after the Industrial Revolution, more and more children began to spend time indoors and focus on education. Fortunately, by the late 1800's some began to realize that education should be used to maintain children's sense of wonder and connection to nature. Many were the beneficiaries of a movement to educate youth about the natural world called the "nature study´movement. Wilbur S. Jackman presented the first known literature for teachers on how and why earth sciences should be taught to youth in America. After graduating from Harvard, Jackman accepted a high school teaching position teaching natural sciences. After years of teaching, he formulated the nature-study concept by developing a guide for teachers seeking to expand earth sciences called "*Nature Study for the Common Schools*." In his book, he outlines a monthly in-depth study of subjects such as zoology, botany, chemistry, geology, and mineralogy. The basis for his ideas is that life is the center of all study and the value of subjects are relative to their level of comprehension. In reference to exposing children to earth sciences, Jackman stated, "The life, health, and happiness of the individual is dependent upon his knowledge of the things about him,

and upon the understanding that he has of their relations to each other and to himself. This knowledge and apprehension of relations can only be acquired by actual personal contact and experience with the things and forces which make up and govern the universe."

## 6.4 Liberty Hyde Bailey and the "Nature Study" Movement

The "nature study" movement was solidified with Liberty Hyde Bailey (1858-1954)(Figures 13 and 14) an early horticulturist, botanist, and educator who was perhaps the "father of nature-based study." Liberty was instrumental in generating tremendous support from community leaders, teachers, and scientists to incorporate the study of nature into science curriculums for children across the United States. Born to a farming family in Michigan, Bailey graduated from the Michigan Agricultural College with a degree in botany and went to work for renowned botanist Asa Gray at Harvard. He later transferred to Cornell where he worked on developing a nature study program for rural schools. Through his efforts in devising bulletins, lectures, demonstrations, and outreach to farmers, the New York State legislature passed a bill to establish the New York State College of Agriculture at Cornell, and Bailey became its first dean. Not only did Bailey work to advance field study education with new departments, he recognized the need to honor woman in academics by appointing the first woman professors at Cornell.

**Figures 13 & 14.** Liberty Hyde Bailey headshot and Bailey family: Liberty Hyde Bailey, Ethel Zoe Bailey, Sarah May Bailey, and Annette Smith Bailey. (Source: http://rmc.library.cornell.edu/bailey/biography/biography_9.html#)

In 1908, Theodore Roosevelt appointed him to chair the presidential Country Life Commission, seeking to promote and advance rural farming societies and investigate ways of making country life more desirable. He wrote many books, essays, and poems. One such book, entitled, "Holy Earth" demonstrates his passion about Mother Earth through powerful statements such as these:

*"We have assumed that there is no obligation to an inanimate thing, as we consider the earth to be: but man should respect the conditions in which he is placed; the earth yields the living creature; man is a living creature; science constantly narrows the gulf between the animate and the inanimate, between the organized and the inorganized; evolution derives the creatures from the earth; the creation is one creation."*

*"Most of our difficulty with the earth lies in the effort to do what perhaps ought not to be done. A good part of agriculture is to learn how to adapt one's work to nature, to fit the crop-scheme to the climate and to the soil and the facilities. To live in right relation with his natural conditions is one of the first lessons that a wise farmer or any other wise man learns."*

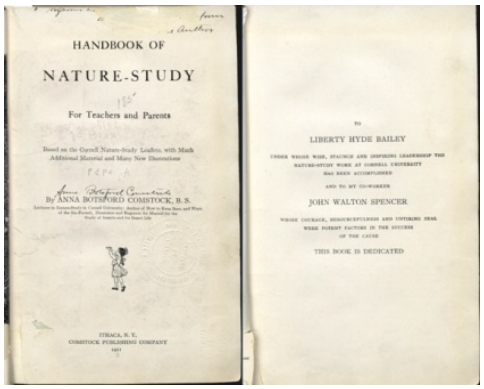
*"Verily, then, the earth is divine, because man did not make it. We are here, part in the creation. We cannot escape. We are under obligation to take part and to do our best, living with each other and with all the creatures. We may not know the full plan, but that does not alter the relation. When once we set ourselves to the pleasure of our dominion, reverently and hopefully, and assume all its responsibilities, we shall have a new hold on life."*

*"The sacredness to us of the earth is intrinsic and inherent. It lies in our necessary relationship and in the duty imposed upon us to have dominion, and to exercise ourselves even against our own interests. We may not waste that which is not ours. To live in sincere relations with the company of created things and with conscious regard for the support of all men now and yet to come, must be of the essence of righteousness."*

Liberty Hyde Bailey, Holy Earth, 1915.

After the depression of 1893, Liberty Hyde Bailey, who strongly believed that children should grow up appreciating nature, received state funds to teach about nature in rural schools. He appointed Anna Botsford Comstock (first woman to attain professorial rank at Cornell, appointed by Bailey in 1899) to help create a *Home Nature Study Course* (Figure 15). They also organized thousands of children into Junior Naturalist Clubs and published a newsletter called, "*Junior Naturalist Monthly"*, beginning in 1899 (Figure 16). Bailey also founded the American Nature Study Society, America's oldest environmental organization, which served to train educators

with workshops, publications, field trips, and conferences. Comstock and Bailey also created a Summer Nature Study School in 1897, which stressed the importance of studying nature.



HANDBOOK OF

NATURE-STUDY

For Teachers and Parents

By ANNA BOTSFORD COMSTOCK, B.S.

ITHACA, N. Y.
COMSTOCK PUBLISHING COMPANY

TO

LIBERTY HYDE BAILEY

UNDER WHOSE WISE, STAUNCH AND INSPIRING LEADERSHIP THE NATURE-STUDY WORK AT CORNELL UNIVERSITY HAS BEEN ACCOMPLISHED

AND TO MY CO-WORKER

JOHN WALTON SPENCER

WHOSE COURAGE, RESOURCEFULNESS AND UNTIRING ZEAL WERE POTENT FACTORS IN THE SUCCESS OF THE CAUSE

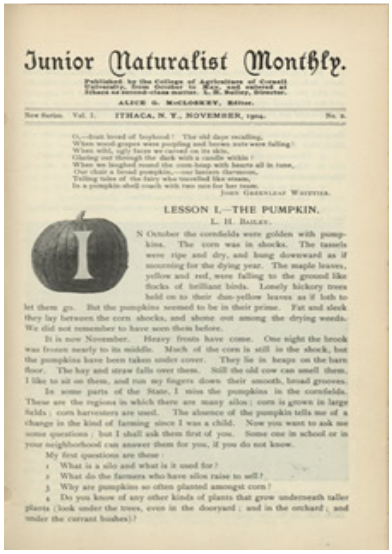
THIS BOOK IS DEDICATED

Home Nature-Study Course

ANNA BOTSFORD COMSTOCK, Editor.

LESSON I.—LEAF STUDY.

**Figure 15.** Anna Botsford Comstock's *Home Nature-Study Course,* 1904, and her "*Handbook of Nature-Study for Teachers and Parents*, 1911. (Source:http://rmc.library.cornell.edu/bailey/naturestudy/naturestudy_11.html#)



Junior Naturalist Monthly.

ALICE G. McCLOSKEY, Editor.

ITHACA, N. Y., NOVEMBER, 1904.

LESSON I.—THE PUMPKIN.

L. H. BAILEY.

**Figure 16.** Image of the *Junior Naturalist Monthly* series, Vol. 1, No. 2, November 1904. (Source: http://rmc.library.cornell.edu/bailey/naturestudy/naturestudy5.html).

To help train people, they devised a pamphlet which highlighted the benefits of nature study for both the child and teacher:

**WHAT NATURE-STUDY DOES FOR THE CHILD**

- Develops powers of observation. Differences between the observation of the child and adult.
- Observation should lead to logical thinking.
- Nature-study gives practical and helpful knowledge.

- Agriculture. Horticulture. Hygiene. Medicine. An understanding of natural laws.
- Cultivation of the imagination by nature-study.
- Cultivation of the perception and expression of the truth through nature-study.
- Nature-study cultivates in the child a love of the beautiful; a perception and appreciation of color, form, and music.
- Nature-study develops in the child a sensible altruism and humaneness.
- Nature-study gives the child a sense of companionship with life out of doors. The value of this.
- Nature-study provides interesting material for thought which may prove a help and an inspiration in other studies
- Nature-study is not meant for drill. The pedagogical value of a study that is not a part of the school drill.
- As nature-study is done directly from nature it teaches the true value of books.

**WHAT NATURE-STUDY DOES FOR THE TEACHER**

- How the nature-study bogy was created; Lack of time; lack of training; exhausted nerves; lack of material; lack of appreciation for the value of comradeship between pupil and teacher; litters the schoolroom; not a part of the regular routine.
- Lack of time—nature-study not another study. A help in other studies. use of recess. Busy work.
- Lack of training—How training may be gained. Sympathy in place of training.
- Exhausted nerves—Out-of-doors interests the best of remedies. The annoyance of discipline obviated.
- Lack of material—It is a part of nature-study for the pupils to provide material. The testimony of teachers on this point.
- The value of companionship between pupil and teacher—The effect of discipline. The salutary effects upon pupil and teacher that comes from the latter learning to say, “I do not know.”

- A study not a part of the regular routine is a rest, a help in discipline, an aid and an inspiration to teacher and pupil.
- Nature-study properly conducted is a great aid to discipline. The testimony of thousands of teachers on this point. The reasons: Sympathy; comradeship; new interests; absorbing occupation.

Liberty Hyde Bailey retired in 1913, but continued his pursuits of scientific, practical, and philosophical ideas, while also traveling extensively on botanical trips to study palms, blackberries, and other species around the world. During his college years in Michigan while working under Dr. William James Beal he learned that using living plants and laboratory work contributed significantly to his understanding of botany. At the time, this was considered a new experimental approach to teaching field science. Even as a young man, Bailey was intrigued and enthusiastic about plants, wildlife, and the natural world. In 1873, at the age of fifthteen, he became the ornithologist and entomologist for the South Haven Pomological Society and delivered a speech titled, "Birds", in which he expounds on the ecological importance of birds.

**Figure 17**. Ethel Zoe Bailey & Liberty Hyde Bailey on the Orincono River in Venezuela, 1921. (Source: http://rmc.library.cornell.edu/bailey/biography/biography_10.html#)

During his lifetime he received numerous awards and honors, he was an accomplished writer, educator, father, husband, and true friend of the natural world. He viewed farmers and the practice of farming as a sacred covenant between man and the earth, and he celebrated the wonders of nature with all who encountered him, especially his daughter Ethel Zoe Bailey who accompanied her father on numerous collecting trips around the world (Figure17).

She helped collect and press specimens and was the curator of his collection (Hortorium) for many years after his death. Liberty died on Christmas day of 1954 and left these parting words:

*"It is a marvelous planet on which we ride. It is a great privilege to live thereon, to partake in the journey, and to experience its goodness. We may co-operate rather than*

*rebel. We should try to find the meanings rather than to be satisfied only with the spectacle. My life has been a continuous fulfillment of dreams."*

# 7.0 ENVIRONMENTAL EDUCATION: JUSTIFICATION AND IMPLICATIONS FOR THE FUTURE

## 7.1 Use of Environmental Education and Its Definitions

The use of the environment in the classroom, schoolyard, or local nature centers and parks has been discovered as an effective way to achieve educational goals and serve the needs of students. However, according to the National Environmental Education Training Foundation, many teachers, administrators, school board members, and others are still unaware of the power and influence of this approach (National Environmental Education Training Foundation 2000).
The United States Congress passed the National Environmental Education Act in 1990, which required the United States Environmental Protection Agency (USEPA) to provide national leadership on increasing environmental literacy and by establishing an Office of Environmental Education to implement this program.

The USEPA defines environmental education (EE) as "a process that allows individuals to explore environmental issues, engage in problem solving, and take action to improve the environment. As a result, individuals develop a deeper understanding of environmental issues and have the skills to make informed and responsible decisions" (United States Environmental Protection Agency). The U.S. EPA identified key components of EE as awareness and sensitivity, knowledge and understanding, attitudes, skills, and participation. They are deliberate in stating that EE does not advocate a particular political view or course of action, but they hope EE strives to teach individuals how to consider opposing viewpoints of an issue through critical thinking.

Here are some other definitions from around the nation:
*"Environmental education is a process which promotes the analysis and understanding of environmental issues and questions as the basis for effective education, problem-solving, policy-making, and management. The purpose of environmental education is to*

*foster the education of skilled individuals able to understand environmental problems and possessing the expertise to devise effective solutions to them. In the broader context, environmental education's purpose is to assist in the development of a citizenry conscious of the scope and complexity of current and emerging environmental problems and supportive of solutions and policies which are ecologically sound" (North American Association of Environmental Education 1983).*

*"Environmental education may best be defined as a process directed at creating awareness and understanding about environmental issues that leads to responsible individual and group actions. Successful environmental education focuses on processes that promote critical thinking, problem solving, and effective decision-making skills. Environmental education utilizes processes that involve students in observing, measuring, classifying, experimenting, and other data gathering techniques. These processes assist students in discussing, inferring, predicting, and interpreting data about environmental issues." (Kansas Association for Conservation & Environmental Education. Source: http://www.kacee.org/what-environmental-education-0).*

*"Wisconsin Environmental Education Board (WEEB): Environmental education is a lifelong learning process that leads to an informed and involved citizenry having the creative problem-solving skills, scientific and social literacy, ethical awareness and sensitivity for the relationship between humans and the environment, and commitment to engage in responsible individual and cooperative actions. By these actions, environmentally literate citizens will help ensure an ecologically and economically sustainable environment." (Wisconsin Association for Environmental Education. Source: http://www.uwsp.edu/cnr-ap/waee/Pages/About/Definition.aspx).*

Urban environmental education is now accepted throughout communities across the nation, but a universal definition has yet to be adopted (Kudryavtsev 2012). In an attempt to narrow the definition to accommodate urban youth which may incorporate a more inclusive and cultural sensitive definition, educators' have recently worked to define urban environmental education.

When USEPA's Office of Environmental Education was established, they formed an Environment Education training component. The most recent phase of this National Training Program is known as the Expanding Capacity in Environmental Education (EECapacity), which works in conjunction with Cornell University's Civic Ecology Lab. A major part of the EECapacity project has been to focus on environmental education efforts and initiatives for urban youth in impoverished communities. Educators from around the U.S. participated in an online training course entitled, "Environmental Education in Urban Communities" and submitted definitions of urban environmental education. Listed below are some definitions submitted which were outlined in a report from Kudryavtsev and Krasny (2012).

*Urban environmental education is a dynamic instructional process designed for diverse, high density populations that imparts basic knowledge and skills related to ecosystems, social justice and civic engagement for the purpose of sustaining safe, healthy, equitable and vibrant city communities.*

*Urban EE seeks to empower historically marginalized communities around issues of local sustainability. It examines ecological principles within urban contexts in order to address some of today's most pressing concerns around water, land, and energy use. As a pedagogical tool, Urban EE serves to inspire students in engaging and meaningful educational experiences that connect directly with their daily realities.*

*Urban Environmental Education is a process through which people living in urban environments can connect with each other; learn about the natural environment; and gain resources and inspiration to care for and improve their neighborhoods.*

*Urban Environmental Education (UEE) is placed-based education that helps people explore, learn about, protect, connect to, and advocate for the built and natural environment in which they live. Good UEE lessons should include social and political issues of equality, equity, and diversity as well as traditional lessons of conservation, nature exploration, science and ecology. Learning should be experiential, combining concept and theory with technical skills to help participants address the unique environmental issues in their community.*

## 7.2 Evidence of the correlation between Enviornmental Education, Academic Achievement, and Ecological/Human Well-Being.

*"A child's world is fresh and new and beautiful, full of wonder and excitement…It is our misfortune that for most of us that clear eyed vision, that true instinct for what is awe-inspiring is dimmed and even lost before we reach childhood."* (Rachel Carson, *"A Sense of Wonder"*1956).

A comprehensive review of research related to the benefits of environmental education reveals positive outcomes. The Center for Ecoliteracy located in Berkeley, California, is a non-profit organization founded in 1995 with the intent of advancing ecological education in K-12 schools demonstrating positive results in urban communities. The Center's website recognizes "students need to experience and understand how nature sustains life and how to live accordingly" (Center for Ecoliteracy ). The center actively engages schools, communities, foundations, filmmakers, and other interested stakeholders to further education that reflects intellect and hope, which they claim is vital to the community. The Center creates books, offers professional development, and provides consulting. They pride themselves on the philosophy that nature is the ultimate teacher and ecoliteracy should seek to promote sustainability as a community practice. They report that over twenty years, socially and emotionally engaged ecoliteracy advances both teacher and student involvement through hands-on, experiential, contextual learning in the natural world and community (Goleman 2012).

In 1995, after concerns mounted about achievement gaps across the nation, combined with the growing movement surrounding the potential for environment education to help students succeed academically, twelve states' departments of education with the support of The Pew Charitable Trusts, united together to create the State Education and Environment Roundtable (SEER). SEER's goals are to promote Environment-Based Education (EBE) as a standards-based instructional tool. The EBE approach seeks to focus on educational results, with the intent of "using the environment to engage students in their education through 'real world' learning experiences, with the goals of helping them achieve higher levels of academic success, as well as an understanding of and appreciation for the environment and issues related to sustainability" (State Education and Environment Roundtable, 2014).

SEER initially gathered to collect and analyze existing research literature from around the world to identity the key issues related to environmental education. The results of their search found that little research was dedicated to the effects of EE on overall educational experiences (Hoody 1996). Since SEER found a lack of sufficient data in the research literature, they designed their own studies on the effects of EE on K-12 school programs. SEER's studies found schools that

were using the "Environment as an Integrating Context" for learning or EIC model. SEER members coined the name of this education model and intended to define EIC programs as encompassing a framework for education that includes interdisciplinary, collaborative, student-centered, hands-on and engaged learning tactics. Although using the EIC model certainly includes learning about the environment, it also encompasses the use of school surroundings and community as a framework for learning. In other words, the EIC model "interconnects 'best practices' in education into an instructional tapestry that improves student achievement by using local natural and community surroundings as a context for learning" (State Education and Environment Roundtable).

SEER conducted their first study of the EIC model in partnership with twelve State Departments of Education. They evaluated student performance in forty across the nation representing thirteen states, and included schools in both urban and rural areas with communities of various socioeconomics. Data produced for quantitative analysis came from site visits, four different teacher surveys, and nearly seven-hundred interviews with students and teachers. Fourteen schools were used to compare EIC students with students from traditional classrooms in the areas of standardized test scores, grade point averages, attendance, student attitude measures, and records of disciplinary actions. Three schools were selected from Southern California (two in San Bernardino and one in Los Angeles) and two schools were selected in the San Francisco Bay Area (Lincoln High School and Piner High School). The major objectives of the study were to identify successful programs, describe their effectiveness, and identify key challenges and successful factors associated with the programs (Lieberman and Hoody 1998).

The results were published in the report "*Closing the Achievement Gap: Using the Environment as an Integrating Context for Learning"* authored by Gerald A. Lieberman and Linda L. Hoody (1998). In the area of science, environment-based education or EIC learning yielded profound positive effects on students. EIC students scored higher on three of four comparative studies of standardized science tests scores when compared to their peers from traditional programs. Teachers and administrators reported the following effects of using EIC to teach science concepts:

- EIC students showed an increase in knowledge and understanding of science concepts.

- Demonstrated a better ability to apply science to real-world situations.
- Showed a greater enthusiasm and interest in learning science.

Michael Melvin, a science teacher from Tahoma High School, Washington, stated the following regarding student enthusiasm and knowledge retention:

*"The kids became so excited about the simple topics that kids didn't become excited about before in traditional classes, they really convinced me that the integrated approach was worthwhile. Now, science-wise…the kids remember things better and for a longer period of time."*

To reinforce the effectiveness and success of the EIC model, other studies have emerged to support implementation of this program. Two separate studies emerged from Florida illustrating that EE programs give way to success especially among Black and Hispanic children. The studies recorded higher standardized test scores, reduced discipline referrals by teachers, increased family volunteer participation, enhanced critical thinking skills and student empowerment, and an increase in achievement motivation (Athman and Monroe 2004; Abrams 1999; Ernst et al 2004). During interviews with teachers, one teacher in particular commented on using the local environment as a motivating context:

*"The environment theme is effective in motivating kids, especially inner-city kids. For many of them, it's their first time interacting with nature, and it's a totally different setting than they are used to. Instead of being on edge, they can let their guards down and have some peace and quiet. It helps rebuild their spirits. And once they feel safe and that someone cares about them, they can care about their education" (Athman and Monroe 2004, pg. 18).*

Even within the first year of implementation, studies have shown remarkably positive results pertaining to student attendance, behavior, and reduction of student disengagement (Falco 2004). Moreover, the California Department of Education funded a SEER study, which evaluated eight

paired sets of students in a comparative analysis between schools with EIC programs and schools without.

**Table 5**. Comparison between student groups that learned from EIC programs versus traditional school programs. In every subject, students learning from EIC programs had higher standardized test scores and grade-point averages, and showed improved attendance. (Source: Lieberman and Hoody 2000).

| **Assessment Content** | Number of Assessments Indicating Higher Scores for EIC Students | Total Number of Assessments | Percent |
|---|---|---|---|
| Language Arts | 69 | 91 | 76% |
| Math | 17 | 27 | 63% |
| Science | 7 | 11 | 64% |
| Social Studies | 8 | 11 | 73% |
| **TOTALS** | **101** | **140** | **72%** |

| **Assessment Content** | Number of Assessments Indicating Higher Scores for EIC Students | Total Number of Assessments | Percent |
|---|---|---|---|
| Attendance | 17 | 22 | 77% |
| **TOTALS** | **17** | **22** | **77%** |

In two case studies, two sets of students were compared within the same school, while six case studies involved different neighboring schools that matched in demographics and socioeconomic factors. Data was generated from standardized test scores, site visits, and teacher surveys and interviews. When standardized test results were compared in areas of reading, writing, math, science, and social studies, the EIC students did better 72% of the time and their attendance was 77% better than the non-EIC group of students (Table 5). The EIC students also exhibited fewer discipline problems, increased enthusiasm for learning, and greater pride in their accomplishments (SEER 2000).

These studies and reports provide significant and persuasive data supporting efforts and initiatives for increased EBE programs across the nation, especially for urbanized youth who lack connection to the natural world and are at risk for acquiring what researcher Richard Louv calls a "nature deficit disorder". Louv, an American author and journalist suggests in his book, *"Last Child in the Woods: Saving Our Children From Nature-Deficit Disorder,"* that children's connections to nature have diminished resulting in negative social, psychological, and spiritual consequences such as depression, obesity, and attention-deficit disorder. His book highlights new research that demonstrates how connections to nature provide a powerful remedy for above-

mentioned maladies. The carton below (Figure 18) showcases one of Richard Louv's main themes with accompanying quote:

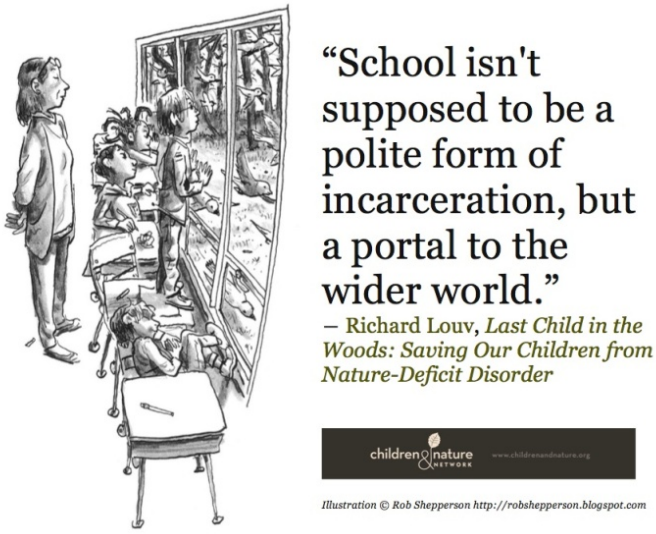



**Figure 18**. Quote and cartoon illustrating the potential for a "nature-deficit disorder" among schoolchildren today. (Source: http://www.childrenandnature.org/).

Unfortunately, students are largely unaware of the importance of urban ecosystems and often they lack the necessary scientific skills to understand how their actions can improve local ecosystems, or how healthy ecosystems can benefit their own lives (Manzanal et al 1999). Research has also shown that when ecology units are taught through environmental science classes in high schools, they often lack proper study of urban ecosystems. The Environmental Literacy Council (2004) found that very few textbooks give serious study to impacts of urbanization and how humans have influenced urban ecosystems. To further reveal the lack of ecoliteracy in our society, a report released by the National Environmental Education and Training Foundation stated that only one to two percent of adults in America can be considered environmentally literate (Coyle 2005). With greater populations living in urban environments, exposure and experiences in natural areas and green spaces becomes limited (Satterthwaite 2000; Verheij et al 2008). Many urban youth may not engage in outdoor activities due to disconnection with family or community. Earle (2009) reported that more than 14 million children are on their own after school and 6.5 million are in after-school care programs. The disconnect with nature at a young age is unfortunate since, research shows that positive experiences in nature as a child help foster connection to the natural world and lead to environmental stewardship as adults (Palmer 1993; Palmer et al 1998; Chawla 1999).

When parents or family members are surveyed, they have demonstrated a shared desire for children to gain more knowledge, understanding, and respect for the natural world. Parents also reveal that more exposure to natural places would foster a sense of compassion, caring, and respect for nature (Bruyere et al 2012). The National Environmental Education Foundation conducted a study of parental interest and found that 96 percent of parents believe that their children should be taught about the environment in classrooms (Coyle 2005). Green spaces appear to attract more community members outside while fostering better community relations, safety, and possibly lowering crime. Community based greening efforts can create a more supportive place to live and contribute to a better overall feeling in inner-city neighborhoods (Kuo et al 1998).

Research also shows that environmental education dedicated to field studies can drastically improve student's connection to the natural world. Around the country, educators are showing that using the urban environment to engage youth is a valuable teaching tool. Barnett et al. (2006) demonstrated that the design and implementation of a field-based studies program could yield positive results such as improved student interest in science, better understanding of scientific methodologies, and an improved sense of environmental stewardship. Additionally, the study of urban soil ecology has been shown to generate excitement about nature in urban areas. Soil systems were shown to have a wide application in urban education, as activities can be developed for diverse audiences, and soil investigations can occur both in a classroom setting, nature center, or even around cracks in the sidewalk (Johnson and Catley 2009). Marten de Kadt (2006) demonstrated how a local urban river was used to engage students in water quality monitoring and restoration while teaching about the history of the community and its environment. Results were shared with local community and government groups thus bolstering the kids' level of pride and self-confidence.

## 8.0 EFFECTIVE PATHWAYS FOR TEACHING URBAN SCIENCE EDUCATION TO MINORITY YOUTH

In the last few decades, national efforts to create a more scientifically literate society have focused on changing standards and gaining higher test scores with the additional aim of closing the achievement gap. In the 1990s, research outlined four main problems hindering the science

education in America: low levels of scientific knowledge, a lack of preparation for using scientific knowledge to make decisions, continued underrepresentation of women and minorities in the sciences, and inadequate science practices in schools (Eisenhart et al 1996). In an attempt to address social and environmental issues, and to create more scientifically literate generations, the alarm sounded resulting in national proposal for science education reform. The two best-known endeavors were National Research Council's National Science Education Standards (NSES 1996) and the American Association for the Advancement of Science's Project 2061(AAAS 1989), which in its first phase published *Science for All Americans (SFAA)* (Rutherford and Ahlgren 1989). Both adhere to the definition of a scientifically literate person as one who is,

*"familiar with the natural world and respecting its unity; being aware of some of the important ways in which mathematics, technology, and the sciences depend upon one another; understanding some of the key concepts and principles of science; having a capacity for scientific ways of thinking; knowing that science, and technology are human enterprises, and knowing what that implies about their strengths and limitations; and being able to use scientific knowledge and ways of thinking for personal and social purposes" (Rutherford and Ahlgren 1989).*

## 8.1 American Association for the Advancement of Science's Project 2061

The reform endeavors of AAAS Project 2061 started in 1985 when Haley's comet passed close to the earth, providing the name Project 2061, intending to signify the year when the comet will pass by again, while also signifying the hope of scientific and technological change in the lifetime of the child that lives to see the next comet. Project 2061 gathered five expert panels of scientists, mathematicians, and technologists to identify important and emerging scientific, mathematical, and technological concepts that should be imparted to the next generation to increase their scientific literacy. The intent of SFAA was to present a vision of ambitious national standards in science and hope to influence educators, parents, school administrators, and policymakers efforts to reform science education in the U.S. SFAA also includes detailed text on effective learning and teaching, reforming education, and steps on how to strive toward reform. With regard to science equity issues, Project 2061 proclaimed:

*When demographic realities, national needs, and demographic values are taken into account, it becomes clear that the nation can no longer ignore the science education of any student. Race, language, sex, or economic circumstances must no longer be permitted to be factors in determining who does and who does not receive a good education in science, mathematics and technology.*

In its recommendations on supporting teaching methods devoted to minorities and woman, the report offers this advice, "Teachers should select learning materials that illustrate the contributions of women and minorities, bring in role models, and make it clear to female and minority students that they are expected to study the same subjects at the same level as everyone else and to perform as well."

## 8.2 National Research Council's National Science Education Standards (NSES)

In 1996, the National Research Council (NRC), which is the research arm of the National Academy of Sciences, made its contribution to the education reform efforts by putting forth a set of "national standards" for science education. The "Standards" intend to provide a guide to the nation toward becoming a more scientifically literate society. Based on practice and research, the "Standards" also hope to fulfill the vision of "literacy for all" presented by the proponents of this initiative. In a similar fashion as SFAA, the authors of this NRC document make a commitment to equity in science for all with their claim:

*All students, regardless of gender, cultural or ethnic background, physical or learning disabilities, aspiration, or interest and motivation in science, should have the opportunity to attain higher levels of scientific literacy than they currently do. This is a principle of equality…This principle…has implications for program design and the education system, especially the allocation of resources to ensure that the standards do not exacerbate the differences…that currently exist between advantaged and disadvantaged students."*

Both SFAA and NSES present compelling initiatives to move the nation in a direction toward better science education for K-12 students. The National Research Council and the American Association for the Advancement of Sciences have spent years compiling information and

research about the current trends concerning science literacy. The content in these documents provide a wealth of information to address the goals of creating a more scientific literate society. Unfortunately, their policy initiatives do little to address the "HOW" of educating impoverished urban minorities across the country. As one reads through the pages, it's clear that the authors ignored research or evidence about how to educate minority youth. The authors seem to suggest that teaching strategies should be uniformly implemented across socioeconomic groups of students. For example, in chapter 13 of SFAA, the heading reads, "Effective Learning and Teaching" which includes a quote supporting woman and minorities under a subchapter that reads "Teaching Science, Mathemathics, and Technology." In the case of Project 2061, the designers specifically mention that "teachers should…make it clear to female and minority students that they are expected to study the same subjects at the same level as everyone else and to perform as well" (Rutherford and Ahlgren 1989). Some education researchers have heavily criticized their work as being colorblind and insensitive to the life experiences and narratives of impoverished urban youth, while viewing their needs through a deficit model (Rodriguez 1997 Lee and Fradd 1998; Barton 2003).

The deficit model makes three basic false assumptions. First, students not versed in the culture of Western science are "lacking" and need to catch up with their White counterparts. Second, it is assumed that students will adopt Western ways of learning, and if they don't accept Western values, it is assumed that they are at fault, not the science instruction. And third, it is assumed that science achievement scores are based on effort and ability as opposed to the degree of assimilation into a system. The rhetoric for promoting "science for all" could in reality be limited to "science for some." While these proposals attempt to promote a democratic social-justice minded paradigm, the guidelines presented fail to address the obstacles and needs of impoverished urban youth, non-English language youth, and minority students.

Critics of the these papers claim that the science for all campaign fails to provide a useful model for understanding the science education needs and life experiences of youth living in urban poverty. According to Barton (2003) the message from the reports imply that minority students behave and act like their White counterparts, and that the teaching strategies should not be modified to accommodate their life experiences. Furthermore, although these calls to action are

positive messages about engaging students in a more meaningful way, these calls can also lead teachers to promote acculturation in an effort to assimilate students to standard policies, practices, and curriculums. Barton provides an alternate method for "re-conceptualizing the deficit model." Table 6 provides framework to of re-conceptualizing our understanding of urban youth achievement, resources, and opportunity.

**Table 6** . Reconceptualizing Achievement, Resources, and Opportunity. Source: *Teaching Science for Social Justice.* Barton 2003, page 29.

| | Deficit Model: What Students Lack | Reconceptualized: What Students Bring |
|---|---|---|
| *Achievement* | High-poverty urban youth lag behind middle-income youth in test scores, high school graduation rates, and school grades | Understanding youth's successes in organized clubs and programs in school, home, and community, while remembering the academic challenges faced by youth in poverty and how these play out in school settings |
| *Resources* | High-poverty urban youth attend schools that lack adequate books, lab supplies, and certified teachers | Understanding the human and social capital that are powerful in youth's lives, while remembering the inequities that high-poverty youth experience |
| *Opportunity* | High-poverty urban youth lack opportunities to experience challenging curriculum and instructional practices and do high-level coursework (i.e., the pedagogy of poverty) | Understanding what it might mean to begin instruction, class, and school design with students' experiences, resources, and interests in mind, while remaining critical of the "pedagogy of poverty" that is often found in urban schools |

The left-hand column of Table 6 lists three prominent categories of the student to school experience juxtaposed to the middle column of 'what students lack' under the deficit model. The deficit model ideology is then compared to the reconceptualized idea of 'what students bring' in the right-hand column.

***Achievement*** is referring to the concept of academic achievement in the traditional sense of evaluating a student performance through high-stake exams, grades, or retention and graduation. Under the reconceptualized notion, the focus shifts to an examination of student success in out-of-school involvement in organized clubs or programs, the home or peer-group setting, responsiveness to youth concerns, youth authority in program development, and sustaining relationships (Nieto 1999; Valenzuela 1999; Fusco 2001). These studies and others like them provide an alternative approach to evaluate student achievement and present a positive and empowering method to engage urban youth living to degradation.

***Resources*** can also be reconceived under this new model. The science education community would agree that all children should have equitable access to resources, but resources are often narrowly defined as only involving instructional texts and classroom material (Rakow 1998). Conversely, literature is highlighting the idea that urban youth carry a certain amount or fund of knowledge and resources by virtue of their family culture, race, or ethnicity. Historically, science

education and schooling have not viewed students "funds of knowledge" as a resource for better connecting and engaging students to science curricula or for teachers using students' knowledge to modify instruction.

Finally, the last category on the anti-deficit table includes opportunity. Educative opportunities reference the ability of educators to recognize that science instruction can begin from the perspective of the student rather than a standpoint of state standards. Opportunities for students to have a more participatory role in the classroom creates dynamic avenues for growth and learning. Thoughtful interventions can lead to empowering experiences for students by focusing on what students bring to the classroom as opposed to what the student lack. This idea forces a re-centering on the purposes and goals of science education in relation to scientific literacy. By purposely accessing the funds of knowledge of low-income minority youth, opportunities for active and engaged participation can be produced.

## 8.3 Funds of Knowledge as a Positive Pedagogical Practice

Urban science educators would agree that teaching and connecting with impoverished urban youth can be challenging, daunting and frustrating. The challenges associated with these environments include lack of resources, inadequate funding, discipline problems, lack of interest in science as a subject matter, and teacher shortages (Basu and Barton 2007; Tobin et al 1999). Teachers also face a "disconnection" with science as it relates to school and community (Boullion and Gomez 2001; Brickhouse 1994). Schools can often contribute to societal marginalization, exclusion, and oppression of youth where their values, beliefs, cultures, and languages are contested (Aikenhead 2001; Calabrese Barton 2003; Campbell 1995; Upadhyay 2009). Some have even written about the harm incurred on minority students caused by expectations to assimilate and disregard different world views or ways of learning (Spindler 1982, 1997; Heath 1983; Philips 1983; Costa 1995; Upadhyay 2009). Regrettably, these problems still reflect issues relating to racial, social, and cultural factors at the core of American society (Pinar and Bowers 1992).

Furthermore, white science teachers can find themselves unprepared or disillusioned by the challenges associated with teaching in impoverished urban environments. For instance, Kenneth

Tobin (2000) a college professor and researcher of urban science education vacated his college professorship temporally to teach at an urban high school where 98% of the two-thousand students were Black. In his autobiographical journal article, he recounts the many difficulties teaching students who were ethnically, culturally, and socially different. He recalled having to learn how to be streetwise by navigating the neighborhood and interacting with others. Tobin also recounts having to negotiate the right to teach the students. He struggled mightily both with teaching strategy and his own stereotypes of impoverished communities. Nonetheless, he was able to learn new pedagogical skills for educating impoverished minorities. He learned that connection to a parent or guardian helped student's success and he advised prospective teachers to understand the elements of social class (i.e. poverty) and ethnic diversity as it relates to curriculum and student participation. His greatest satisfaction came when a student stopped him in the street and acknowledged him as his science teacher.

Fortunately, there is growing body of educational research that shows how educators can better connect and relate with urban youth, especially with students representing various cultures and races underrepresented such as African Americans, Hispanics, Asians, and American Indians. Teaching urban minority youth requires transformative ways of identifying and connecting with the social and cultural resources of students (Tobin et al 2001). Research has shown that accessing the students "funds of knowledge" can sustain interest in science among urban minority youth. Tapping students funds of knowledge involves recognizing that life experiences of an individual within a family or community can yield knowledge that is "useful, powerful, and transferable" (Basu and Barton 2007). Attempts to access students "funds of knowledge" in science teaching and learning has been explored in recent studies (Boullion and Gomez 2001; Hammond 2001; Seiler 2001; Gonzalez et al. 1992; Gonzalez and Moll 2002; Upadhyay 2009).

Gonzalez and Moll sought to develop innovations in teaching by using the knowledge learned from student's households. They endeavored to understand how households responded to changes in social and economic circumstances. Based on their research, if teachers are able to visit households and interview families, they can form a better understanding of their students and transfer that knowledge back into the classroom. Efforts to explore student's families can also serve to establish relationships that become the basis for exchanging information and

building trust with the community. This tactic can serve to validate and recognize the struggles that many students bring into the classroom. Tapping the funds of knowledge within families can also serve to bridge the gap between teachers and students that represent different races or cultures.

Environmental science lessons present unique opportunities for teachers to connect funds of knowledge and science concepts. For example, gardening and food has been shown to provide an excellent topic for connecting students and their families funds to science concepts related to food webs, plants, seeds and soil (Upadhyay 2009). This also demonstrates that local cultural knowledge can be blended with Western scientific concepts and ideas. Culturally sensitive curriculums and lessons can help students relate with the material, helping the transitions between familial culture and Western culture. This process of cross-cultural teaching creates better citizens in society by promoting mutual respect between teacher and student, especially when honoring many beliefs, which teach that Mother Earth is sacred (Aikenhead 2001).

Additionally, Delgado-Gaitan's (1996) work with immigrant families in California demonstrate how parent and teacher attitudes, school programs, and organizational structures changed in one school district when human and social resources (language, home and community –based practices, activities, and celebrations) from immigrant families was brought to school and acknowledged in a public setting.

Angela Calabrese-Barton (2003) illustrated this point in her research while operating an after-school science club at a homeless shelter in Southwestern Texas. Interestingly, Barton endeavored on her pursuit of examining the possibilities of science education for homeless children after she was homeless for time. During her homelessness, she contemplated the homeless youth of America and the challenges associated with schooling, especially in science. In 2010, more one million children experienced homelessness during at

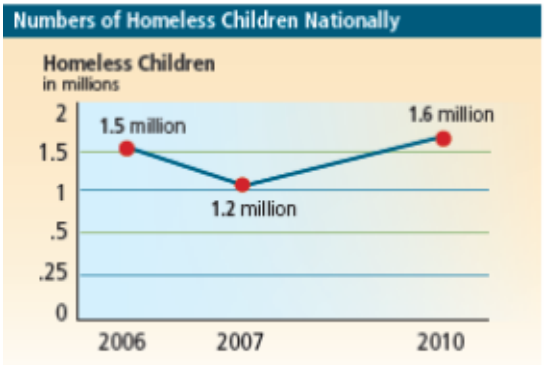



**Figure 19.** Number of homeless children in the U.S. 2006-2010. (Source: The National Center on Family Homelessness 2011).

some point during the year (The National Center on Family Homelessness 2011).
On a single night in January 2013 roughly twenty-three percent of the homeless were children while Texas, California, and Florida account for fifty-eight percent of the unaccompanied homeless youth (U.S. Department of Housing and Urban Development 2013).
When Barton was asked about her endeavor with homeless children, she stated,

*"I wanted to use science as an agency to empower them…I wanted to help people who teach science to understand the connection between the larger social context of living in poverty and just surviving in school…Science can be fun, but it has an integral role in our society… I want to help these children use science in a way to make their lives better." (Teachers College, Columbia University 1997).*

This research provided a unique glimpse of lives of children in poverty attempting to remain in school and survive difficult circumstances, since the shelter was located adjacent to a local crack house. The focus of her research can be summarized in the following three questions: How do homeless children construct their identities in science? How can science be used as a productive force in their lives and be created out of their experiences? Moreover, what do teachers need to know to teach children in extreme poverty?

In regards to students skills, she was able help channel the leadership skills of a gang leader to conduct and produce a video documentary about life and science in the inner city. As this young boy's enthusiasm grew, he started to help clean the property and plant vegetables in the garden, which eventually led him to gain the confidence he needed to attend school again. Barton notes from her experience that a student's individual knowledge, skills, expertise and relationship among peers and family are important resources for teachers to incorporate into science curriculums.

One of the many challenges associated with teaching science to youth, especially in impoverished urban schools, is the principal of sustaining interest in science. Maintaining a "sustained interest" has been defined as having an "enduring disposition" of science or pursuing self-motivated science exploration outside of the classroom as well as using science to improve, expand, and enhance activities in which students are already engaged (Hansen 1999; Basu and

Barton 2007). Accessing students funds of knowledge contributes to sustaining interest through personal empowerment. Students will then likely embrace and further investigate what they are learning instead of resisting participation and engagement. Basu and Barton (2007) conducted a critical ethnography of a low-performing middle school in New York City. Critical ethnography is a methodology of research focused on "participatory critique, transformation, empowerment and social justice" with a framework of documenting, analyzing, and acting on the discriminatory practices supported by urban schools (Basu and Barton 2007; Seiler 2001). Using this methodology on three middle school students sustained interest in science, the study revealed that their interest was correlated to the level by which the science material incorporated their identity, beliefs, experiences, and conceptions of their future. Figure 21 demonstrates that sustained interest starts with the student's funds of knowledge transferring to their "visions of the future" and "agency for enacting their views on the purpose of science." This also contributed to how they valued their relationships and how their learning environment became structured. Once a learning environment was established based on empowerment, youth developed a sustained interest which lead to self-motivated explorations outside the classroom and they delved deeper into to school curriculum, as depicted by the bottom of the flow diagram (Figure 20).

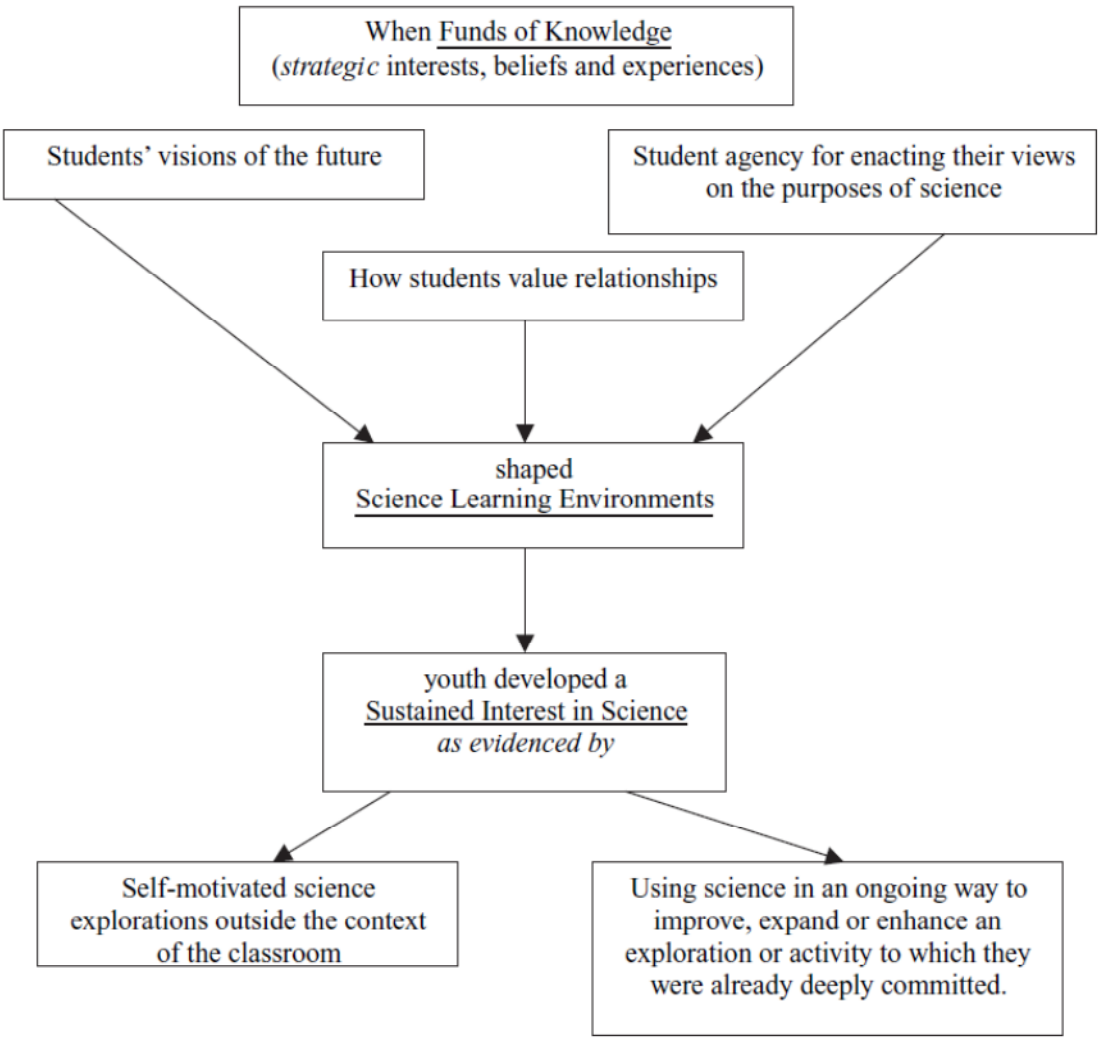



**Figure 20**. A flow chart depicting the connection between a student's funds of knowledge and a sustained interest in science. (Source: Basu and Barton 2010).

Tan and Barton (2010) conducted a ethnographic case study (research method designed to study the culture of a group through observation) of a sixth-grade science teacher and his classroom. The teacher named Mr. B, an Irish Italian American in his early 30s, was the only White person in his classroom. This northeastern school has a demographic of 45% Black and 55% Hispanic, with 90% of students being on the free lunch program. Mr. M was described as being a tough disciplinarian who deeply cared about his students, and worked to understand their lives while using that understanding to teach. He is quoted as saying this about his students:

*"I think most of the students that I teach, you know, have value, and you know they shouldn't just be cast aside. And if I give them an opportunity and a safe environment, they'll rise to the challenge . . . It is, it's them feeling comfortable and not*

*being intimidated and frightened. I think it all goes back to, just, them sensing that what you're trying to do for them is valuable, where it's not abstract and unusable . . . [Also], you don't know why they are in this [high poverty, urban] environment, but it doesn't mean that they aren't as intelligent and motivated."*

The researchers focused on students engaged with science in different ''figured worlds'' in the classroom and how Mr. M facilitated student engagement, as well as focusing on learning outcomes from students and community. Over a two-year period of classroom study, data was collected from field notes, video-footage, and interviews with students and Mr. M. The classroom was a popular place for students, indicated by the frequency of students dropping by before their first class started. Mr. M used his classroom space in unique and dynamic ways. Live animals (hamsters, frogs, fish, snakes, and a praying mantis) and a plant growth station adorned the classroom allowing students to engage more deeply in science. Mr. M routinely used class discussions, presentations, small group work, and individual work to engage students, encourage collaboration and camaraderie. The term ''figured worlds'' mentioned above refers to the different spaces that allow for various forms of student participation, and the concept of ''third spaces'' denotes spaces where learners are empowered as legitimate experts in the community with valuable resources. Urrieta (2007) writes about the transformative power of figured worlds and gives insight about how figured worlds generate opportunities for student progression:

*Through participation in figured worlds people can reconceptualize who they are, or shift who they understand themselves to be, as individuals or members of collectives. Through this figuring,individuals also come to understand their ability to craft their future participation, or agency, in and across figured worlds. (p. 120)*

In this evaluation of teacher and student relationship, the researchers identified three distinct ways that Mr. M facilitated figured worlds. He allowed for story-telling, being real, and authentic science-based participation. For instance, Mr. M had his class divide into small groups with each having to make an appetizer with accompanying poster presentations demonstrating nutrition and food elements. The groups made grilled chicken kabobs, smoothies, and breakfast entrees. Other instances include incorporating Michael Jackson, a well-known pop artist, into the conversation about sunlight and skin pigment when one girl asked about her friends light skin. By using Michael Jackson as an example, Mr. M modeled for his students that nontraditional knowledge and awareness of pop culture can be used to transform science curriculums geared for urban

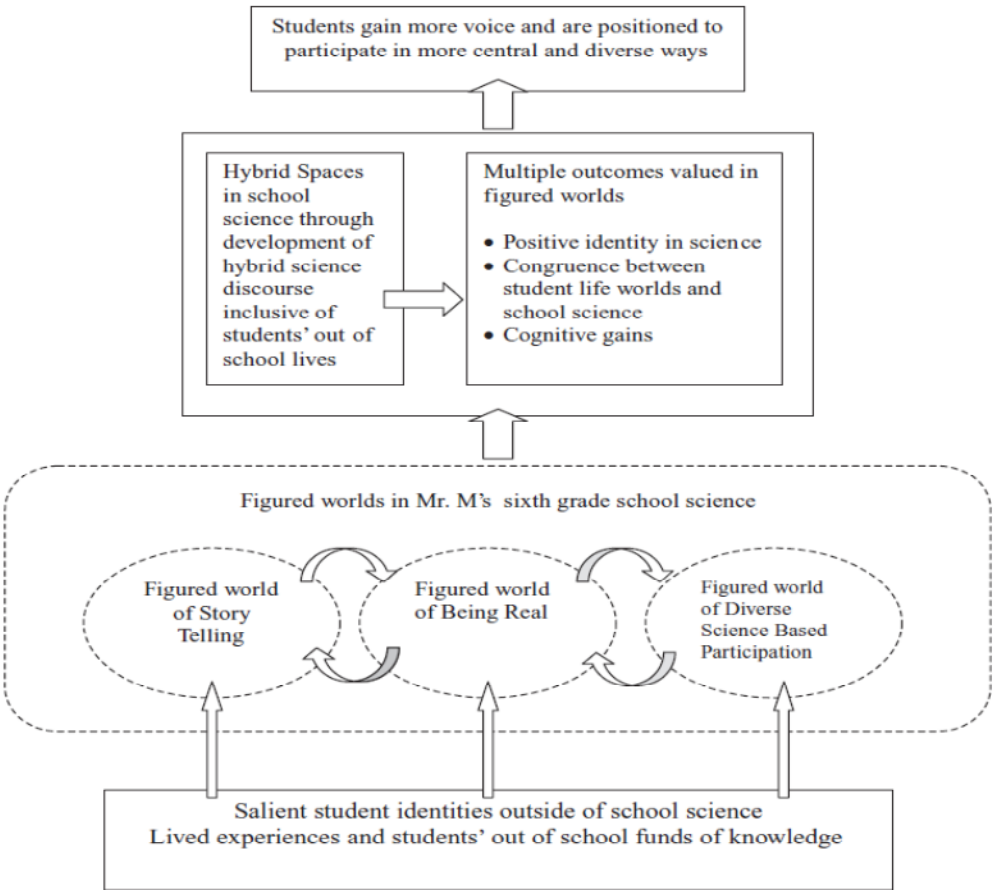



**Figure 21**. Progression flow chart from student's funds of knowledge to central and diverse participation expressed through third spaces and figured worlds. (Source: Tan and Barton 2010).

minorities. He also showed that nontraditional areas of knowledge could be acceptable resources for classroom discussion. The researchers observed that Mr. M showcased an ability to encourage figured worlds through teaching practices which played a pivotal role in determining learning outcomes. For instance, Mr. M provided had students create science portfolio's where they could choose to display work for which they were satisfied. This allowed for student autonomy and opportunities for students to engage relevant topics at a deeper level based on interest and enthusiasm.

Figure 21 shows the forward movement of momentum expressed in Mr. M's classroom starting with the students out of school funds of knowledge being transferred into the figured worlds of story telling, being real, and diverse science-based participation. The figured worlds are interconnected and eventually lead to cross-cultural discourse expressed as hybrid spaces that support both teacher instruction and values the students out of school lives. This generates opportunities for multiple outcomes such as positive identities in science, congruence between student life and school science, and cognitive gains. As indicated by the flow chart, the result is

students are empowered with a voice positioned to participate in more central and diverse pathways.

## 8.4 Hip-Hop, Social Justice, and Environmental Education

Another emerging innovative teaching strategy for urban minority youth is organizing opportunities to utilize hip-hop or rap music to bring student voices into the classroom, influence curriculum, pedagogical practices, and the construction of knowledge. Although rap music has been vilified by mainstream media and government officials as being controversial, hip-hop can be used as a transformative element in developing critical teaching and thinking. Rap music has evolved from rhyming on the street corners of South Bronx to a multi-billion dollar international industry (Land and Stovall 2009). Hip-hop culture and lyrics have focused heavily on narrating the stories of living in poverty, while some artists have focused entirely on the negative experiences associated with inner cities across the country (Light 1999; Rose 1994). As hip-hop has spread across the nation, it has further represented various regions by differing dialects, terms, styles of dress, dancing, and rapping styles. Rap music has described urban spaces and the cultural interactions within, exemplified by more mainstream artists including 2 Live Crew in Miami, Notorious B.I.G. in New York City, Bone Thugs-N-Harmony in Cleveland, The Geto Boys in Houston, Eminem in Detroit, Ice-T and N.W.A. in Los Angeles. Since hip hop reflects a wide range of distribution and subcultures, it will always provide an opportunity to express social commentary and social critique (Land and Stovall 2009). Rap artists such as Mos-Def, Talib Kweli, Common, Dead-Prez, KRS-One,Tupac Shakur and Jay-Z have all written lyrics about the conditions of ghettos, slums, and oppression in America. They have included school systems, jail systems, political systems, and the larger society as a whole. This excerpt below is from a Tupac Shakur song that reflects both the experiences in a typical Black ghetto, as well as social commentary:

*"I huffed and puffed about my curfew and broke the rules,Ran with the local crew, and had a smoke or twoAnd I realize momma really paid the priceShe nearly gave her life, to raise me right And all I had ta give her was my pipe dream Of how I'd rock the mic, and make it to tha bright screen I'm tryin to make a dollar out of fifteen centsIt's hard to be legit and still pay tha rent And in the end it seems I'm headin for tha penI try and find my friends, but they're blowin in the wind Last night my buddy lost his whole*

*family, It's gonna take the man in me to conquer this insanity It seems tha rain'll never let up I try to keep my head up, and still keep from gettin wet up,You know it's funny when it rains it pours, They got money for wars, but can't feed the poor, Say there ain't no hope for the youth and the truth is, It ain't no hope for tha future, And then they wonder why we crazy, I blame my mother, for turning my brother into a crack baby, We ain't meant to survive, cause it's a setup, And even if you're fed up, Huh, ya got to keep your head up." (Tupac Shakur, "Keep Ya Head Up" 1993).*

Hip hop has also been shown to stimulate learning to increase ecological literacy. Cermak (2012) describes how he implemented a new educational initiative using environmentally themed (green hip-hop) rap music in an environmental science classroom. After being inspired by the rap song, ''New World Water'' by Mos Def, Cermak endeavored to find a ''balance between teaching about nature with the rational and logical language of my schooling and the social, metaphorical, and deeply historical perspective provided by Mos Def'' (p. 193). The rap lyrics of ''New World Water'' describes the world's fresh water crisis while integrating themes of ecology and racial injustice.

*"New World Water make the tide rise high*
*Come inland and make your house go "Bye"*
*Fools done upset the Old Man River,*
*Made him carry slave ships and fed him dead nigga…*
*Fluorocarbons and monoxide*
*Push the water table lopside*
*Used to be free now it cost you a fee*
*Cause oil tankers spill they load as they roam cross the sea*
*Man, you gotta cook with it, bathe and clean with it…*
*And everybody in the world can agree with this*
*Consumption promotes health and easiness*
*Go too long without it on this earth and you leavin it*
*Americans wastin it on some leisure shit*
*And other nations be desperately seekin it*
*Bacteria washing up on they beaches*
*Don't drink the water, son they can't wash they feet with it…*

*Fluorocarbons and monoxide*
*Got the fish lookin cockeyed*
*Used to be free now it cost you a fee*
*Cause it's all about gettin that cash"*

With the onset of environmentally conscience lyrics such as this song, some argue that rap, when it places emphasis on urban spaces and environmental injustices could be considered environmental literature. In Rosenthal's (2006) assessment of environmental literature, she suggests that ecologically informed rap music constitute an urban environmental discourse, offering examples of writing that challenge the traditional environmental literature from figures like Henry David Thoreau and Aldo Leopold, who usually dominate environmental course material in syllabi, conference panels, and scholarly publications. Rosenthal also claims that even though rap isn't considered ''green'' writing, rap artists and their music can expand ecological literacy and help redefine ideas about what constitutes ecological writings.
During the two-week curriculum, Cermak focused on urban environmental injustices and listening to green hip-hop. As with other curriculum initiatives, he had to construct lessons that were related to state-mandated concepts, and student classwork needed to address those concepts. They looked at local cases of non-white citizens living near vacant lots and brownfields, studying how pollutants such as lead can potentially impact human health. The curriculum enabled students to learn about community organizations taking action to remediate the problems and build connections between science content and urban environmental activism. After case studies were read and discussed, they were asked to write a creative response to the case studies which had to include an environmental justice theme with ecological terms and concepts. Candace, a seventeen-year-old Black student submitted this written page:

*I watch and stare as the toxins fall down,*
*The matter recycled from everyone in town.*
*The poor to consume the dirt and the dust,*
*mercury and lead poison from the metals that rust.*
*The ocean's contaminated and the water we drink,*
*will damage the minds of the ones who must think.*
*The selfishness of the rich*

*to intoxicate our fish*
*is indeed profitable but death isn't our wish*
*Environmental injustice should be stopped*
*Cuz the feelin' of me dyin' leaves my mind distraught.*
*This point of view is from me the minority*
*striving for environmental equality!*

Candace was able to make connections about the ecological food web and biomagnifications of metals through the environment. She also incorporated her own verbal style to bridge the gap between environmental pollutants in human communities to soil and fish contamination. Her own hopes and despair are woven through the poem as she declares life over death from environmental pollution. She ends the poem by stating her racial identity in relation to her activist point of view by stating her desire for a better world.

After analyzing more than 200 creative pieces over four years, Cermak showed that hip-hop could be used as an effective Critical Ecological Literacy (CEL) tool for racially diverse learners in urban areas. The students creative pieces incorporated and manifested into many themes, most notably their native language, various ecological ideas, role playing and empathy, their living places and experiences, threads of civic activism or empowerment. The student-produced texts also served as a method of student-to-student transmission of environmental knowledge. The material would be read and shared with youth growing up in similar conditions, and served to prepare and motivate other students to write deep and powerful pieces of their own. Cermak concludes by stating that this tool can be altered to any music genre (folk, soul, etc), but what is important is that learners blend the curriculum with their own style. They hope to share this project with others and foster a more inclusive form of education about nature and society while challenging others to do the same.

In another example of progressive and innovative efforts to transform the science experience of inner-city minority youth, Elmesky (2003, 2005) reported on a National Science Foundation funded project called Discovering Urban Science (DUS). The purpose of DUS was to employ youth from economically disadvantaged backgrounds in Philadelphia as student researchers. The focus of their efforts were to gain a deeper understanding of how to improve the teaching and

learning of urban youth. The student researchers participated in a variety of capacities from learners to curriculum developers in different spaces including the workplace, neighborhoods, homes, and science classrooms. Since one of the goals for the youth participants was making science more accessible to other youth, they understood that gaining respect from peers was critical. It is widely understood that respect from other juveniles comes from knowledge and ownership of the streets (Anderson 1999). This ownership leads to high levels of respect or status in neighborhoods and forms relationships with peers. This study demonstrated that the youth's knowledge and understanding of hip hop represented a medium through they could express an understanding of science and its potential for personal empowerment. One student, named Kareem created a rap lyric to connect "hip hop and the streets" with "science and the world" when he was asked about how he explains science to other urban youth. Kareem states, "Science is everything and I'm science. The world and everything in it is science. And I'm science so the world is mine…" To further illustrate their use of innovative practices, the student researchers worked on making a film entitled, *"Sound in the City"*, which focused on the science concepts of sound, wavelengths, amplitude, and the physical interpretation of frequency as pitch. The film included singing and music segments that demonstrated how students' high levels of energy and rhythm contribute to their "contextualization and connection with scientific abstraction." Elmesky concludes by suggesting that science learning for marginalized populations should be used as a tool to achieve an expanded form of agency. In addition, children should have opportunities to express similar sentiments as Kareem when saying, "I am science so the world is mine."

## 9.0 PLACED-BASED ENVIRONMENTAL SCIENCE EDUCATION AND ITS IMPLICATIONS ON ECOLITERACY AND STEWARDSHIP

Opportunities for impoverished urban youth to experience the ecological elements of their communities are often limited leading to disconnections and nature-deficit disorders. To further exacerbate the lack of interest in environmental sciences, research shows a disconnection between school science and students day-to-day lives as well as cultural or linguistic barriers to the establishment of interest in science (Basu and Barton 2007; Nieto 1994; Roth and Tobin 2007). Research also suggests that traditional school science experiences do not facilitate beliefs that students can be stewards of the environment (Gough 2002; Hudson 2001; Legault and

Pelletier 2000; Tran et al 2002; Worsley and Skrzypiec 1998). Yet, a sense of urgency exists about critical challenges associated with the effects of human activity on the environment. Environmental health (air, water and soil degradation), strains on nonrenewable resources, food supply and agriculture, oceanographic and marine resource disruptions, and climate change are just a few of the environmental problems that students will need to be prepared to resolve.

Student knowledge about human social systems (economic, laws, culture, politics, etc) and how they interact with natural systems in the environment is vital to the process of restoring what has been lost or damaged, maintaining functioning systems, and introducing and facilitating sustainable practices in relation to agriculture, resource management, marine environments, and human communities. As Lieberman (2013) suggests, connective instruction to local environments, allows teachers to engage students through authentic lessons that support students efforts to achieve greater academic success. This also allows educators and communities to capitalize on what author and scientist E.O. Wilson (1984) calls human "biophilia." The biophilia (love of life or living systems) theory states that all humans are born with the capacity to "affiliate with other forms of life", and that people respond positively to open, grassy landscapes, scattered stands of trees, meadows, water, winding trails, and elevated views.

With the increased awareness about the positive impacts of nature-based or environmental based education, it is relevant to discuss recent case studies involving connection between urban youth and their environments. The environmental education literature also suggests a renewed and growing interest in the study of "sense of place". Even early pioneers in environmental education such as Bailey (1911) recognized that "We are more likely to know the wonders of China and Brazil than our own brooks and woods." Fortunately, a growing movement exists that validates the sentiments of Leopold (1949) and others about how outdoor landscapes offer us many aspects of learning such as esthetic, ethical, economic, and ecological.

## 9.1 Environmental Education and Sense of Place

The concept of sense of place has various definitions from a psychological approach, but for the purposes of this literature review, the definition used here will invoke an ecological element. Sense of place can be defined as "a living ecological relationship between a person and a place…including physical, biological, social, cultural and political factors with history and

psychological state of the persons who share the location" (Kincheloe 2006). Kudryavtsev et al (2012) argue that environmental education programs use two fundamental approaches to influence sense of place, experiential and instructional. The experiential element of influencing sense of place refers to attempts to strengthen place attachment through direct and frequent positives experiences in outdoor environments. While instructional is more traditional since it encompasses lectures, storytelling, books, art, movies, websites, and other forms of media. The combined approach ultimately nurtures an individual's sense of place. The literature described below is dedicated to highlighting efforts from around the nation to educate urban youth from a place-based standpoint ad also provides a summary about the outcomes of such endeavors.

## 9.2 Research from the Urban Ecology Institute of Boston College

*"Urban ecosystems are not well understood, but they are absolutely critical to the health, economy, and quality of life of people who live in urban areas."*
--Charlie Lord, Co-Founder, Former UEI Executive Director (Source: http://www.urbaneco.org/history.html)

The Urban Ecology Institute (UEI) was created in 1998 with the intent of working with schools and community groups to investigate natural environments within urban settings. They also started an urban ecology field-based studies program (UEFSP) in partnership with Boston Public School Teachers designed to improve students understanding of the relationships between built and natural environments, while building the capacity of community groups to green their neighborhoods. As of 2012, UEI's field-studies program has been implemented in more than twelve Massachusetts cities, more than one-hundred schools, and since 2002, has educated more than twenty-thousand students. The students who participated were in grades 9-12, and represented the Boston Public Schools demographics of mostly low-income Black and Hispanic youth. In addition to their work in Massachusetts, in 2012 UEI formed a strategic alliance with Loyola Marymount University in Los Angeles, California. UEI provides a proven set of scientific field-studies curricula and teacher training materials to help LMU's efforts to engage the youth of Los Angeles County Unified School District, through their new LMU Center for Urban Resilience and Environmental Studies programs.

The UEFSP program aims to engage students in the scientific process by integrating urban ecosystems with basic scientific research. They employ the educational process of inquiry where the students address the question, "What is the health of Boston's urban ecosystem?" They work with teachers to develop science units that participating schools use to augment their existing science curriculums. Urban ecology, called by some as the most "important frontier for educators" includes core skills and concepts relating to urban ecosystem education that are well established in national and state science education standards (Hollweg et al 2003). Urban ecology science components offer the power of science combined with active learning of and in service to the local community (Berkowitz 2003). Urban ecology curriculums also help transform traditional classrooms and related materials by substituting classroom lectures with field-based studies.

UEI provides three main services through their educational division: professional development, field research, curriculum materials, and annual student conferences (Barnett et al 2006). To assist teachers in the implementation of the field-studies portion, UEI provides trained assistants to work directly with students and consult with teachers to help prepare classroom and field lessons. With regard to field curriculum materials, UEFSP provides numerous lesson plans covering topics such as, water quality monitoring, avian diversity, behavior and ecology studies of coyotes, crows, and turtles using radiotelemetry. The materials equip teachers with information on how to conduct, prepare, and analyze data. The conceptual framework is geared to enhance the learning experiences gained through field research and connect the curriculum to state standards. Each school involved in the program conducts research at a given study area within the city. Local watershed associations, environmental agencies, and UEI help the teacher's select field sites that are mostly located close to school where they can afford to carry out long-term comparative studies.

According to teacher interviews during a two-year study of the program, students displayed a change in perspective regarding stewardship of their local environments. Through participation in the UEFSP, many students commented about science helping them understand the world around them. One student remarked:

*"I'd like to do some science work but the Neponset River was kind of dry…This is a question I'd like to ask: Why weren't there a lot of creatures out there…no nothing…it was just dry…it was just water. I'd like to know what's up with that."*

Teachers also observed improved self-confidence from the students as a result of participation in the program. In one occasion, as the students were walking out to their field study site with their testing equipment, the students were bragging to other kids in the hallway that they were going to do "real science" outside. The students in the program succeeded in collecting and analyzing significant amounts of data and presented their work at the year-end conference. One teacher commented, "A lot of people said inner city kids can't do science and they proved them wrong. Our kids enjoy being out in the environment and I hope next year we'll get more opportunities to do that." The program provided valuable opportunities for students to engage in real-world problems affecting their neighborhoods and they developed a sustained involvement in scientific processes through their investigations throughout the year. The field-based program also provided a unique scientific laboratory setting to augment the absence of school laboratories within the school district. This helped students better understand their responsibilities to care for their local environment (Barnett et al 2006).

## 9.3 The Bronx River: A Case Study for Local Watersheds as a Classroom

The Bronx River, like many rivers situated in industrial urban areas of America has a long history which tell the story of change throughout our country's brief history. The river once supported a rich array of flora, fauna, and Native American communities. The river was called Aquehung or "River of High Bluffs" by the Mohegan tribes who once fished and lived along the river. Early European traders in 1600's were attracted to the river for the large populations of beavers that flourish there. One of these traders, Jonas Bronck, purchased land around the river from the Mohegan Indians and by the mid-1700s, nearly twelve manufacturing mills were operating along the river. The river's ecosystem was prized for its scenic forests and clean waters, and by the early 1800's the local community debated ways to distribute the river supply as drinking water. As industrial forces grew, the river became polluted with sewer discharges and since the 1880s, efforts have focused on protecting the river from increased urbanization. In

1885, the river's natural headwaters were cut off with the construction of Kensico Dam forming Kensico Reservoir. By 1905, Westchester County began to absorb sewage discharges small development buffers along the river were constructed (Bronx River Alliance).

Today, the Bronx River still experiences commuters and industries along its banks, but is also serves to support fish, birds, and recreation. Since the construction of the dam, the river now meanders approximately twenty-four miles from Valhalla and then southward through Westchester County. The river flows through the Bronx Botanical Garden and Bronx Zoo, before spilling into the East River which is a tidal straight that connects the Hudson River Estuary to Long Island Sound. Before the Bronx River empties into the East River, it passes by Fannie Lou Hamer Freedom High School, named after the iconoclastic civil rights activists Fannie Lou Hamer (1917-1977). The schools website displays the motto, "Step up. Stand out. Move forward." The fundamental mission of the school "is to teach students to use their minds well and prepare them to live productive, socially useful, and personally satisfying lives" and their approach states:

*"At Fannie Lou Hamer Freedom High School we emphasize students learning to use their minds well in pursuit of college and career readiness. Students and teachers work together to create a community of caring and concerned citizens committed to meaningful work. Students develop critical thinking, research and analytical skills in preparation for college and careers and technology is used to maximize individualization, independence, and depth of learning..." (Fannie Lou Hamer freedom High School)*

Since the river offers a rich social, cultural, and ecological history, teachers have used the river as a teaching tool for science, history, culture, and civic engagement. The river has also received tremendous amounts of attention towards environmental restoration and public recreation for communities along its banks. In the shadow of this interest, Maarten deKadt (2006), a social studies teacher at the school, documented students efforts to monitor the water quality of the river by sampling, testing and analyzing data collected. At the time of this study, the student body reflected a low-income group with over 90% eligible for free or reduced lunches. The students were 75% Hispanic, and 25% Black. For 25% of the students, English was a second language, while 19% were classified as Special Education. The school also educates 40-50% of students that are over age, since many of them have repeated grades in an effort to graduate.

Fannie Lou Hamer Freedom High School is a staff-run school which results in lower administration overhead permits and smaller classroom sizes. When deKadt arrived to teach, he was advised to "teach what you want to teach", which lead him to teach both environmental and community studies programs. In the fall of 1998, he and the students started to test the waters of New York's only fresh water river. They used large compound buckets attached to clotheslines supplied by the schools custodial staff. They tested the rivers pH and dissolved oxygen under different seasonal conditions and evaluated if the conditions allowed fish to survive. Eventually, their data was shared with community groups also monitoring the Bronx River such as the Bronx River Alliance (Figure 22). This increased the kids' sense of pride and self-confidence as their work was valued by organizations outside of the school. The students were also given a sense of importance for their work when a hotly contested debate ensued over whether an abandoned concrete plant should be converted to a park or an access road to the local market. deKadt had his students grapple with the issue and write position papers expressing their opinions about the matter. Many articles in local media outlets focused on the history and significance of the Bronx River and seeing their write-ups gave the students a renewed sense of pride about their water quality monitoring efforts near the concrete plant.

**Figure 22**. Students sampling the Bronx river with the Bronx River Alliance. (Source: http://bronxriver.org/?pg=content&p=aboutus)

deKadt and others were able to expand their environmental science program by including ecological lessons on the local estuary by testing water sampled for salt. The kids could see the various levels of salt content as they moved closer to the estuary. deKadt was able to acquire funds from the Catskill Watershed Corporation to purchase additional sampling equipment to samples differing depths of the river. The school administration, deKadt, and other teachers also started to include field trips to Kensico Dam and Reservoir where the students learned about drinking water systems, Bronx River ecology, and social policy. They also embarked on sailing trips around the Hudson River to demonstrate the connectedness of the riverine and estuarine systems.

The Bronx River has provided a unique and empowering opportunity for the students of Fannie Lou Hamer. deKadt demonstrates how a local river and watershed can be used as an environmental classroom to increase kids sense of place, create empowerment through community outreach, and connect to local ecosystems through scientific study and exploration. deKadt concludes by stating, "…the Bronx River—a wonderful opportunity for students to gain real world research experience and to improve their academic skills. Not only will they gain in endeavor, so will the community—their community."

## 9.4 A Local Case Study: Eastside College Preparatory School and Jasper Ridge Biological Preserve

Eastside College Preparatory School in East Palo Alto engages and educates impoverished minority youth with environmental science by facilitating an ecological field studies program for sixth graders in partnership with Stanford University's Jasper Ridge Biological Preserve. The programs key players are Eastside's sixth-grade teacher, Stanford students, Jasper Preserve's education coordinator, and volunteers from the community. Eastside Preparatory School provides one of the few opportunities for students living in East Palo Alto to graduate high school and go to college. Drugs, gangs, and violence had shattered the city and caused the local high school to collapse in 1976 amid inner city busing and white flight. East Palo Alto was once the "murder capital of the world" in 1992, after the city of 24,000 people recorded forty-two murders, outpacing Oakland and Washington D.C. Ever since the high school closed, students were bused to neighboring high schools in the affluent areas of Menlo Park, Atherton, Woodside, and San Carlos. The placement process of non-college tracking classes caused students from East Palo Alto to drop out of high school at a rate of 65%.

During the early 1990's, Stanford graduate Chris Bischof started an after-school program for East Palo Alto elementary school students with the focus of basketball and daily tutoring. The program, called "Shoot for the Stars" was limited in its breadth, and could only provide a few hours a day. In 1996, Chris and fellow Stanford graduate Helen Kim acquired funding and established the new high school, which welcomed eight ninth graders who meet at a picnic table. They soon moved to a computer-learning center and used an empty room for instruction.

Eventually a donor offered an empty lot for the construction of a modular building and the next year they enrolled thirty-five students. Today the school enrolls nearly 350 students' in grades 6-12 with a demographic of 63% Hispanic, 33% Black, and 4% Pacific Islander. Eastside boosts an incredible 100% graduation rate with 100% of students being accepted into college, while 98% of students are first-generation college bound. Eastside graduates have attended Stanford University, Santa Clara University, Pomona College, University of Pennsylvania, Tufts University, Princeton University, U.C. Berkeley, Columbia University, Amherst College, Yale University and Harvard University. Eastside graduate Kiazi Malonga went on to graduate from Stanford and remarked, "We're a surprise. Like a rose growing from concrete" (Jasper Ridge Biological Preserve ).

**Figure 23**. Cindy Wilbur, education coordinator at Jasper Ridge Biological Preserve helps students search for organisms from creek water samples. (Photo courtesy of Jack Kearns).


**Figure 24**. Suney Park, Eastside sixth-grade teacher and Presidential teacher of the year recipient. (Source: www.welcomebooks.com/american teacher

Shortly after Eastside was formed and established, Cindy Wilbur (Figure 23), education coordinator at Jasper Ridge Biological Preserve approached the school and offered to implement a field-based study program for science students. Her intent was to immerse students in nature and give them opportunities to be scientists in nature while learning ecological concepts. Currently, the sixth grade teacher Alma Suney Park (Figure 24) invites her students once a week for three months to embark on an ecologically based field studies program. Eastside has only one class in $6^{th}$, $7^{th}$, and $8^{th}$ grades, and the sixth grade class is the only self-contained classroom in the school. Consequently, Suney teaches math, science, social studies, language arts, and reading to her sixth graders. At the time of this interview with Suney, she had just returned from Washington D.C. to receive the national presidential award for teacher of the year. Since Eastside is an extended-day school (8am-5pm), and nearly 30% of

students live on campus in full-time dormitories, teachers like Suney devote an incredible amount of time and energy to the children, especially with preparing them for college and negotiating their difficult family situations. In my interview with Suney, she called her teaching position, a "calling" referring to her career at Eastside as her "ministry" suggesting how entrenched the staff are with the students.

Her sixth grade class (24 students: 17 Hispanic, 6 Black, and 1 Pacific Islander), are taught earth science, as keeping with state education standards. Her ecology unit begins in the spring and is taught through the remainder of the year. It is during this time of the curriculum that Suney brings her class to Jasper Ridge once a week to begin ecological investigations. They travel eight miles to the headwaters of the San Francisquito Creek Watershed near Searsville Dam located on the Jasper Ridge Biological Preserve. Jasper Ridge encompasses amazing geologic, topographic, and ecological features within its 481 hectares (1,189 acres) of pristine habitat. The preserve serves to facilitate valuable natural laboratories for researchers, educational experiences to students and guests, and refugium for native plants and animals to thrive. The preserve's ecosystems are tightly managed to allow scientists to quantify changes in similar ecosystems affected by human impacts. Since 1965, research at the preserve has produced 335 publications and 165 dissertations.

Cindy Wilbur and Suney collaborate to create the ecology curricula. It begins by dividing the class into ecological subgroups, each with a specific habitat. The ecosystem groups include creek, oak woodland, chaparral, and marsh wetland. As part of the assessment of the program, they offered opportunities to observe, document, and help teach the youth about ecology. They begin in the classroom at the Jasper Ridge education center with a short welcome and a brief lecture on various ecological concepts. There were 6-8 undergraduate and graduate Stanford students who were trained by Cindy and other Earth Science professors to teach mini-lessons in environmental science. Also in attendance were a number of community volunteers and docents that help assist and enhance the learning experiences of the youth. As the students approached, a slow and steady excitement filled the room with anticipation of their arrival. As they walked through the doors, they were greeted with excitement, hugs, loud chatter, and jovial embrace. The kids arrived with joy and fervor. They had been waiting all week for their field trip, and one could observe their general approval and happiness with the program. Waiting on their desks

were their T-shirts bearing the name “Eastside Field-Studies”, a water bottle, folders, wildlife bandanas, and name tags.

**Figure 25**. Eastside field-ecology student sampled the air temperature with a sampling probe. (Photo courtesy of Jack Kearns).

After receiving a short lesson on birds and insects, the group departed for their research areas. The creek ecosystem group began a series of investigations regarding the air, soil, plant, and animal diversity of their given habitat. They had measuring tools to assess the temperature of the air, water, and soil. To start, students documented general conditions of the area, followed by individual tasks of measuring the temperature of the soil, water, air (Figure 25), pH of the water, and tree canopy cover. After sampling and documenting general conditions, the students returned to their respective plant species. Each had a plant to monitor over the course of the program. They measured plant height, soil conditions, canopy cover, and any unusual observations. The data was recorded on their sheets and they were encouraged to draw their observations of insects, plants or birds during their field analysis. Mayfly larvae were hiding under small branches in the creek and the students observed and documented their findings. One student identified the presence of spittlebug nymphs occupying his plant, and the Stanford student who was leading the group described what they were, including the meaning of the frothed-up plant sap which resembles spit. The student was then able to teach the other students about his new discovery and write about his observations. The group proceeded to walk downstream and look for insects living near and in the water. Insects observed were documented and discussed upon finding them. The group leader found field mice living in a box in the bushes. They walked toward the mice quietly and softly. Once at the metal box, it was lifted slightly and the kids watched the mice as they stared back in curiosity and wonder. In turn, the students were excited and thrilled to witness a family of mice living in their shelter. After finishing field analysis, the class walked back to the classroom where Cindy had made lunch for the entire group. There is a high level of scientific discovery and exploration in the program. The children were polite, friendly, and respectful during the entire field trip. The youth appeared genuinely interested and excited about their experience with nature and their ecosystems. After

eating lunch together, the class concluded with one of the student teachers conducting a review of the different group experiences. When asked about their favorite or "coolest" things observed, the students were eager to share their observations with the rest of the group. When it was time to depart, the class formed an orderly line and individually thanked each volunteer and staff member participating in the program. This program was formed because of compassion and commitment for social justice and community partnership. Cindy implemented this program allowing the marginalized youth an opportunity to connect and discover nature.

## 10.0 FROM NATURE WITH LOVE: THE EVIRONMENTAL EDUCATION MOVEMENT & EXAMPLES OF HOPE SERVING TO CHANGE OUR CHILDRENS FUTURES

Many exceptional efforts around the country are supporting and giving energy to the environmental education movement. Communities, educators, and youth are beginning to respond to the timeless sentiments expressed by the late John Van Dyke when he asserted, "Was there ever a time in human history when a return to Nature was so much needed as just now? How shall the nations be rebuilt, the lost faith and hope renewed, the race live again, save through the Great Mother whom we have forsaken?" The "No Child Left Inside" movement, named after the controversial No Child Left Behind Act of 2001, has grown out of the recognition that youth of America are increasingly becoming disconnected to their outdoor environments. Increasing awareness about research indicating the academic benefits of environment-based education has also contributed to a national and state push for education reform.

The No Child Left Inside movement also fulfills the many calls of early environmentalists and educators that first-hand experiences with the natural world contribute to children's emotional well-being and connection to the world. To deny urban minority youth the opportunity to discover and connect to the natural world is equivalent to denying the human spirit. George Washington Carver, a renowned African-American scientist born under slavery and poverty may have articulated it best when he stated, "…nature in its varied forms are the little windows through which God permits me to commune with Him, and to see much of His glory, majesty, and power…To those who have yet not learned the secret of true happiness, which is the joy of

coming into the closet relationship with the Maker and Preserver of all things: begin now to study the little things in your own door yard, going from the known to the nearest related unknown for indeed each new truth brings one nearer to God." For many humans, a sense of balance is developed by natural curiosity and wonder expressed in outdoor settings. Walt Whitman wrote about this phenomena in his poem, "There was a Child went Forth":

*"There was a child went forth every day,*
*And the first object he look'd upon, that objecthe bacme,*
*And the object became part of him for the day or a certain part of the day,*
*Or for many years or stretching cycles of years.*
*The early lilacs became part of the child,*
*And grass and white red morning glories, and white and red clover,*
*and the song of the phoebe-bird,*
*And the Third-month lambs and the sow's pink-faint litter,*
*and the mare's foul and the cow's calf…*

Connection, education, and exposure to the natural world are central to emotional and spiritual development. Despite the fact, that many urban areas are void of functioning and pristine ecosystems, the fundamental principles of environmental science allow teaching opportunities to be imagined in any living space. Communities everywhere contain threads of ecology, and elements of the natural world are intertwined into daily life. The materials we use to build cities, the clothes we buy, the food we eat, the water we drink, and the air we breathe, are all facets of daily life that echo ecological significance and can translate into teaching opportunities. Any science teacher in the United States can walk outside the school walls and teach an earth science lesson based on the surrounding environment. Breathing the air can lead to a discussion or an activity about air quality and atmospheric chemistry. Where does the air we breathe come from? How does it cycle through the environment? What is relationship between oceanic phytoplankton and the air we breathe? These questions and many others can lead to thoughtful discovery and student inquiry. Environmental inquiry is the basis for environmental education, and replacing the classroom worksheet or PowerPoint presentation with a walk through the neighborhood cataloging trees or studying the soil between the cracks of the sidewalk can yield benefits (Johnson and Catley 2009).

Ecological principles and insights can be easily prepared and simplified for urban settings and schoolyards. Jane Kirkland, author of "No Student Left Indoors: Creating a Field Guide to Your Schoolyard," abruptly vacated her lucrative career as a computer software engineer to write a book that helps educators discover nature in their own schoolyards. She remembers being inspired by seeing a Praying Mantis on the side of high-rise building in the middle of downtown Philadelphia, and a dragonfly trapped in the cell phone store at her local mall. In San Francisco's downtown financial district, Peregrine falcons use building nest boxes placed at PG&E's headquarters. Viewing cameras were installed to allow the public to watch the nestlings and monitor their status, further reminding us about urban ecosystems. On the evening May 6, a mountain lion from the Santa Cruz mountains wandered through Los Altos and eventually ran through downtown Mountain View. Fortunately, this lion was tranquilized and released back into the Santa Cruz Mountains. This is another stark reminder that urban city centers once supported thriving food webs with much biodiversity.

Between 1800 and 2009 in the Unites States, the percentage of population living in urban areas increased from 5% to 79%, and today nearly eight of every ten Americans live in urban areas. Almost half (48%) of all Americans live in cities of 1 million or more people, which is projected to increase as urban sprawl continues to grow (Miller and Spoolman 2010). Despite the negative associations with urbanization, urban areas do have advantages. They serve as centers for economic development and technology, and they provide better access to healthcare than in rural areas. Urban areas can also provide environmental benefits, which include feasible recycling programs since funds are more readily available, and concentrating people in cities helps to preserve biodiversity by reducing stress on wildlife habitats.

Unfortunately, urbanization leaves a huge ecological footprint by polluting the environment and consuming resources at a high rate. Since urban areas can be isolated from forests, grasslands, streams, and other natural areas, it remains critical to initiate efforts of outdoor exploration and investigation. Outlined below is a summary of recent efforts nationally and locally to integrate the outdoor environment into school curriculums, serving as examples of hope and inspiration.

## 10.1 National "No Child Left Inside" Campaign

In response to growing concerns about narrowing curriculums, nature deficit disorder, and childhood obesity, a national coalition was formed to advocate and support environmental literacy programs in public education through legislation entitled No Child Left Inside (NCLI). According to Chesapeake Bay Foundation, one of the non-profit organizations leading the NCLI movement, the No Child Left Behind Act (NCLB) has reduced environmental literacy by narrowing science curricula in order to meet stringent state and federal assessments. Emphasis has been placed on teaching toward questions on state science tests forcing many teachers to spend less time on environmental education. Teachers have become discouraged from providing valuable field-based education to their students based on a fear of "loss of instructional time" for tested subjects (Chesapeake Bay Foundation). Consequently, vibrant, innovative student-led, community-supported environmental investigations and restoration projects have been curtailed. NCLB Act does not include any language to address environmental education, and as mentioned before, the Office of Environmental Education is organized under the U.S. EPA, not Department of Education.


**Figure 26**. Congressman John Sarbanes (Democrat , MD) lead author of the NCLI bill. (Source: http://sarbanes.house.gov/ ).

The No Child Left Inside Act of 2008 was introduced by Senator Jack Reed (Democrat, Rhode Island) and was passed by the House of Representatives 293 to 109. On April 22, 2009 (Earth Day) another similar bill was introduced by John P. Sarbanes (Figure 26) with 82 co-sponsors and was referred to the House Committee on Education and Labor. In 2013, Reed and Sarbanes joined to reintroduce the bipartisan NCLI Act into 113$^{th}$ Congress with 13 Senate cosponsors and

42 in the House. The aim of NCLI Act is to amend and strengthen the NCLB Act by including funding to train teachers on how to deliver high quality environmental education including the utilization of local environments as an extension of the classroom. The Act also seeks to create incentives for states to develop State Environmental Literacy Plans including field experiences to help insure that every student is prepared to understand the environmental challenges of the future.

The NCLI Act also hopes to encourage teachers, administrators, and school systems to make time and resources available for environmental education for all students. One of the provisions focuses on building partnership grants between school districts, colleges, parks, environmental organizations, and other community groups to implement professional development for teachers about the use of field-based experiential learning to provide innovative and interdisciplinary instruction for students. The reintroduced bill of 2013 seeks to reflect the efforts of many states that have already developed plans and programs for increasing environmental literacy. Support for the NCLI Act is fueled by a growing national coalition started by the Chesapeake Bay Foundation. As of 2011, the NCLI coalition has participating members from every state totaling three-thousand business, health, youth, faith, recreational, environmental, and education groups representing over fifty million Americans. Member groups and organizations are informed by email about the current status of the NCLI Act, asked to contact media outlets and members of Congress, and asked to coordinate advocacy efforts on behalf of the NCLI Act.

## 10.2 Ahead of the Pack: California's Education and Environment Initiative


California has become the only state to adopt and develop an innovative Environment-based Education curriculum used as a context for teaching and learning school subjects. Leslie Tamminen, the former Legislative Director and Staff Attorney for the environmental non-profit

organization Heal the Bay, worked with Assemblymember Fran Pavely to draft a bill which would integrate the ocean and environment related content into state standards. Senator Fran Pavely (District 27), a former classroom teacher and supporter of environmental protection, teamed up with Tamminen to meet with representatives of California's education and environmental agencies. Pavley would eventually author Assembly Bill 1548, which called for the development of "education principles for the environment" that would be taught by integrating the state's existing science and history/social science standards into new curriculum units. The Bill was passed and signed into law by Governor Gray Davis in 2003 and was called the "Education and the Environment Initiative" (EEI). The California Environmental Protection Agency (CalEPA) and Integrated Waste Management Board (IWMB) were given management and oversight responsibilities and EEI consultants (State Education and Environment Roundtable and The Acorn Group) were responsible for the design and development of EEI plans and instructional materials.

In an effort to launch the program, the CalEPA and IWMB worked to broaden its constituency and become well informed about the importance of the state's educational priorities, including state standards, curriculum frameworks, student assessments, and State Board of Education policies. They also worked to build relationships with California's environmental organizations, business communities, and professional education organizations, such as the California Teachers Association. Over an eight-year process, the EEI team conducted numerous meetings with stakeholders to develop Environmental Principles and Concepts to create the new EEI curriculum. The EEI team established Technical Working Groups with over 100 environmental experts representing state and federal agencies, universities, industry, and non-profit organizations. They embarked on a process of designing the K-12 curriculum by surveying 10,000 California teachers for guidance. The surveys requested information about the design of the curriculum, teacher preference on how to receive final materials, instructional materials, and types of professional development that would be most effective.

Before drafting a curriculum, the EEI team created an Interagency Model Curriculum Planning Committee to provide guidance and review on-going development of the proposed curricula. After a final draft was approved, release of the new EEI curriculum to teachers and students

began in early 2011 with on-going implementation hoping to reach every teacher within California's 1,057 school districts. The California EEI website provides educators, students, parents, and communities with a comprehensive overview of the EEI program, its goals, and directives. The homepage includes an introductory video with EEI stated purpose:

**Use the EEI Curriculum to:**

- Replace old lessons with new, up-to-date materials that engage your students in topics that matter to them - the air they breathe, the water they drink, the food they eat.
- Cultivate your students' understanding of their relationship with the environment.
- Make learning relevant and fun!
- Prepare your students to be critical thinkers and 21st century problem solvers.
- Encourage your students to be responsible stewards of the earth.
- Teach History-Social Science and Science standards to mastery, and support California ELA and California Common Core standards for ELA and Literacy (K-12)

(CalRecycle- Education and Enviornment Initiative ).

## 11.0 FINAL THOUGHTS

*"Hey! Lean to hear my feeble voice.*
*At the center of the sacred hoop*
*you have said that I should make tree to bloom.*
*With tears running, O Great Spirit, my Grandfather,*
*With running eyes I must say*
*The trees has never bloomed*
*Here I stand, and the tree is withered.*
*Again, I recall the great vison you gave me.*
*It may be that some little root of the scared tree still lives.*
*Nourish it then*
*That it may leaf*
*And bloom*
*And fill with singing birds!*
*Hear me, that the people may once again*

*Find the road*
*And the shielding tree.*

This Earth prayer from *He□áka Sápa* (Black Elk), an Oglala Lakota Sioux medicine and holy man, speaks to the spirit of hope and renewal. My hope, as stated in the introduction was to instill a renewed sense of hope about future generation's ability to care take and maintain proper stewardship of the planet's life-giving sources. As long as human societies exist, there will inevitably be tension between humans and the natural world. As human populations and communities continue to grow and become more urbanized, youth will continue to require connection to the natural world. Urban minority youth are high risk for academic underachievement and marginalization from discovering the hidden treasures of ecological features. Promoting environmental science education for urban minority youth combines the quest for social, environmental, and academic equality. As shown in the research, efforts to engage and empower youth can result in many benefits. However, Freire (1971), and Barton (2003) remind us that education "must be about working with people to tear down the barriers that separate, sort, and label individuals and social groups hierarchically based on their social, cultural, and economic backgrounds."

Infusing innovative teaching strategies such as funds of knowledge and hip-hop can help tear down those barriers and help to create a more inclusive classroom. Once educators can adapt and modify lessons to attract and sustain interest in science, the relationship of teacher and student has the potential to grow in trust and in humility. Forming a bond with "at –risk" students and their families can help to foster a comfortable learning environment where the child seeks to learn and discover new things. Since impoverished minority youth often bring a unique set of difficult challenges to school, teachers need to be prepared to accept various roles with students. In my interview with Suney Park, the sixth grade science teacher at Eastside College Preparatory School, she confessed that she often takes the place of an absent parent in order to help guide the children, especially kids from non-English speaking households. The lack of English speaking parents can create barriers to understanding the educational needs and aspirations of the youth. As a result of the many challenges presented to the urban youth teacher, they must become socially justice minded and must learn how to teach for social justice.

The phrase “knowledge is power” is truly applicable to the life experiences of impoverished urban youth. Endeavoring to engage the youth through environmental education carries the enormous potential to empower the individual with knowledge and hands-on experiences. As Dr. Carter Godwin Woodson reminded and articulated to the world, “The mere imparting of information is not education. Above all things, the effort must result in making a man think and do for himself…” As Dr. Woodson’s words are contemplated, the students of Eastside school come to mind. They were empowered with knowledge and were guided toward a destination. Once the children were immersed into nature’s fold, they became junior ecologists fueled by instinct and intrigue. The kids, who come from high-poverty families in densely populated ghettos, are awakened to a new sense of wonder and surprise each and every time they embark on their outdoor classroom.

Before this research project was started, a hypothesis was formed about the potential for environmental science to transform the educational experience of urban minority youth. First-hand investigation of this program and careful study of similar programs prove that environmental science education indeed offers the best opportunity for educators to engage urban youth to a science discipline, form connection with and discover the outside world through field-based projects, help youth engage their communities through “eco-citizenry” projects, and provide a pathway for hope and healing.

The Eastside Field-Ecology Program satisfies the vision depicted in the mural created by youth from East Palo Alto. The mural (shown below) illustrates the connection between individual inner-peace, peace in the community, and harmony with Mother Earth. The mural helps us to understand that peace and harmony can exist with a renewed sense of place and a commitment to understand the connections between social and environmental justice. Urban science education offers more than just tests, worksheets, and laboratory experiments. Thoughtful and inclusive science instruction with a social justice agenda produces urban “eco-warriors” capable of transforming their communities and giving them hope to change their futures. The environmental education movement is a powerful tool that can be used to reform education and close the achievement gap. However, its effectiveness will depend on the level of inclusiveness and cultural sensitivity incorporated into programs.

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