

Advanced Placement Environmental Science and the Curriculum and Community Enterprise for Restoration Science (CCERS) Project in the New York City High School

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Received: December 3, 2017

Accepted: December 19, 2017

Online Published: January 5, 2018

doi:10.5430/jct.v7n1p7

URL: <https://doi.org/10.5430/jct.v7n1p7>

Abstract

This paper explores the issue of social justice through the lens of equitable access to Advanced Placement courses in the City of New York High Schools, with focus on Advanced Placement Environmental Science. A critical component of the Advanced Placement Environmental Science course is the incorporation of environmental fieldwork. The National Research Council (2014) suggest that field stations are important for STEM education and provide opportunities to engage students in the natural environment and get them excited about science. Through the Curriculum and Community Enterprise for Restoration Science, an NSF funded opportunity, students in the Advanced Placement Environmental Science course are integrating their field station work in Oyster Restoration in the New York City Harbor. These interactions with the environment offer unique experiences which engage marginalized students in both rigorous coursework and affords equity in science learning. In turn, it affords all students the opportunity for upward mobility and increased career opportunities in the area of STEM.

Keywords: *social justice; field stations; advanced placement courses; A.P. Environmental Science; Billion Oyster Project; human capital; STEM*

1. Equity, Social Justice and Science for All

“Equal but separate”(Note 1).....words that today, are indicative of injustice and disparity. Although this term referred to separate facilities for all manner of life for African-Americans; such as housing, medical care, schooling transportation and employment, the focus of this paper will be on education. African-American students were blatantly denied access to an equal education in the 19th Century. This became more covert in the 20th Century and exists even today in the United States. As stated in *Inequity Matters* (Carter & Reardon, 2014), many historically disadvantaged groups continue to face limited access to various opportunities even in the absence of explicit legal obstacles.

The words “social justice” invoke different responses from different constituents in urban education. Students tend to describe social justice as tackling the issue of fairness to everyone, including those from different ethnic, socioeconomic and language backgrounds. Educators see this as decreasing the disparities between the different students groups. National and state representatives may see this as having every student accountable for attaining the same level on high-stakes tests regardless of the inconsistencies in resources and human capital. At the outset of this article, defining social justice is an important first step in developing the framework needed to begin the discourse on socially just education for all. A conventional definition of social justice is “a value or desire to increase access of power, privileges and socioeconomic resources to people from socially marginalized groups.”(Goodman, 2015) Educationally speaking, these socially marginalized groups include but are not limited to students living in poverty, disabled students, female students and students from racial and cultural minority groups.

The reasons for these breaches in socially just education are complex and researchers have proposed a number of explanations. One possibility is the difference of opportunities to learn because of inequities in instruction in schools and districts; instruction that should be made more inclusive by motivating diverse student populations. Equity in science learning occurs when individuals from diverse backgrounds participate in science as practiced in the established scientific community and centers on making science accessible, meaningful and relevant for diverse

students by connecting their home and community cultures to science (National Research Council, 2009).

2. New York City's Efforts to Level the Playing Field

On November 7, 2017 Mayor Bill DeBlasio was re-elected with ease for a second term as the Mayor of New York City. Arguably, the strongest reform of his administration was the NYC School improvement initiative, foremost being "Equity & Excellence for All". The NYC Department of Education, with Chancellor Carman Farina at the helm, immediately began the deconstruction of the Bloomberg/Klein initiatives in 2013. With the re-election Mayor Bill DeBlasio, the Department of Education will retain the DeBlasio/Farina current structure which has been evolving for the last four years. This contains several tiers, but most notable is the fact that the Chancellor's Initiatives (Note 2) that were begun under the tenure of School Chancellor Carman Farina will remain in place and continue to foster and grow. Some of the most successful are organized into three key groupings:

1. Academic Excellence – Universal Second Grade Literacy, Pre-K for All, Computer Science for All, Advanced Placement for All and Algebra for All
2. Student and Community Support – Single Shepard, College Access for All – Middle School, College for All – High School, Community Schools, NYC Summer Meals
3. Innovation – District-charter Partnerships, Renewal Schools, Field Support Centers, SchoolFinderNYC.gov, ELL Translation Services

The scope of this article does not allow for an in-depth study of all of these initiatives, but rather, serves to focus on the initiative that is arguably the most forward thinking in terms of social justice and equity for all high school students in New York City – Advanced Placement classes for all students.

Setting a number of ambitious goals, the Chancellor has stated that by 2026, 80% of the students in the New York public school system will graduate from high school on time and two-thirds will be college ready. College ready is an ambiguous term but in regard to the City University system of New York City and the State University system of New York State, it loosely means that students will enter college without the need for remediation and can start earning college credits immediately upon entering college in their freshman year.

New York City is perhaps the most diverse city in the world. It is the most populous city (8.5 million) in the United States as well as the most densely populated (27,000 per mile²). Over 3 million of the city's population is foreign born with a quarter of these residents arriving after 2000. NYC is home to the largest Jewish and Israeli communities outside Israel, the largest Asian Indian population in the Western Hemisphere, & the largest Russian American, Italian American, African American, Dominican American, Puerto Rican American and South American populations in the United States. (Note 3)

Despite the ethnic and racial diversity of the city, the New York City public school system is sorely lacking in the diversity found in individual schools and districts. With more than 1.1 million children and 17,000 schools, this is no small task. A majority of New York City schools are segregated with 71% of public schools intensely segregated and only 23% of schools diverse. The data also show the disparities across boroughs, which is illustrated in the charts below (Note 4).

Table 1. Intensely Segregated NYC Schools

Share of Schools that are Intensely Segregated* by Borough	
Bronx	95.5%
Brooklyn	71.5%
Manhattan	66.3%
Queens	59.9%
Staten Island	11.4%

*90-100% of the student body is comprised of students of color

There is a great imperative to increase the diversity in the school system. In May of 2015, the New York City Council passed the School Diversity Accountability Act, aimed at both documenting the sources of the problem and devising policies and programs that would promote diversity.

According to the National Coalition on School Diversity (2016), students in diverse schools perform better on proficiency tests than students in segregated schools. The coalition analyzed student performance data for students in

diverse and intensely segregated schools and found that citywide, students in diverse schools are more than twice as likely to meet proficiency standards in English Language Arts (ELA) as students in intensely segregated schools. These disparities are even greater in some school districts. For example, in School District 13 in Brooklyn, 47.4% of students in diverse schools are proficient in ELA, while in the same district only 9.3% of students in intensely segregated schools are meeting proficiency standards. A similar trend is observed in math proficiency scores.

The New York City Department of Education conducted studies on diversified and segregated high schools and found that segregated schools were not offering courses that are considered rigorous; courses that would be considered college and career readiness in nature. Urban students in high-poverty schools or schools with high minority enrollment have limited access to high-level math and science courses and are disproportionately tracked into low-level classes; classes where students spend more time reading from textbooks and completing worksheets and are expected to be passive learners rather than active users and producers of disciplinary knowledge (Barton, et al, 2003).

Research shows (Ewing & Howell, 2015) that students who take AP courses and exams are more likely to graduate from college on time and that the greatest gains are made by low-income students and students of color. However, nearly 40,000 New York City high school students are enrolled in schools that did not offer any AP courses. In high schools that do offer AP courses, there are wide disparities in participation and performance for black and Hispanic students, as well as English language learners and students with disabilities. Public schools in urban environments such as New York City, struggle with the fact that many schools are residentially segregated. Minority students are enrolled in schools with much higher levels of poverty (Anyon, 2005). These schools struggle with a wide assortment of issues including neighborhood poverty, homelessness and teacher shortages.

There is no one factor that is responsible for the disparity in the schools that do not offer AP courses, but there are several contributing elements. For instance, most of the segregated high schools were started during the small school movement of the Bloomberg/Klein era begun in 2002 when Michael Bloomberg gained control of the New York City School system. Although this initiative had mixed results (Center of New York City Affairs, 2010; MDR, 2015) one adverse consequence was the limited course offerings available in the smaller high schools. Smaller populations of students limit the elective choices in high school and therefore smaller schools tend to focus on the core course offerings that are needed to obtain a high school diploma. National and local data (National Center of Educational Statistics, 2015) show that students of color, students with disabilities, low-income students, English language learners and female students are underrepresented in college-level and rigorous coursework.

As part of the AP for All Initiative, the New York City Department of Education is effecting positive change by increasing Advance Placement participation in high schools among students of color and low-income students who are not currently enrolled in AP courses. This fall, an additional 1,400 students began work in these courses throughout the city. There will be an additional 118 (Note 5) AP courses, including 52 in STEM subjects. The ultimate goal, set for the year 2021, is that high school students in all city public schools will have access to at least five AP classes during their high school tenure. This expanded access will not only afford the students advanced coursework but will also teach them the skills and strategies needed once they enter post-secondary education.

STEM is the acronym that is given to the combined content areas of Science, Technology, Engineering and Mathematics. Of the 38 Advanced Placement courses offered by the College Board®, thirteen can be considered to be STEM courses (Statistics, 4 types of Physics, Environmental Science, 2 types of Computer Science, Biology, Chemistry & 3 types of Calculus). College credit is conferred to those students who earn a 3 or higher on the Advanced Placement Examination given in the spring

3. A Case Study for Incorporating CCERS into the Advanced Placement Environmental Science Curriculum

One of the Advanced Placement courses that is most appealing to high school students is the Advanced Placement Environmental Science course. Environmental education is one of the fastest growing fields of students and leads to a plethora of college majors and career opportunities. Students are given the opportunity to learn about the natural world around them through field studies, hands-on laboratory investigations and observations. It is an interdisciplinary course offered by the College Board and as such, can be approached through the lens of variety of natural world settings. Firsthand laboratory and field investigations are strongly encouraged as this is a course that stresses environmental science and not just environmental studies. Science for all is a moral and ethical imperative. It opens the door to high-paying professions and demystifies urban environmental issues (Barton, 2002). It levels the playing field by giving all students an equal opportunity.

As stated by Marcia McNutt, the President of the National Academy of Science, “Field stations provide the best

connection between a growing population and the wonders and mysteries of the natural environment. These institutions educate on what all citizens must do to preserve ocean health, the foundation of the basic ecosystem services that keep our planet habitable". Although New York City is considered to be the cultural and financial capital of the world, it is also considered the home of arguably, the most beautiful natural harbors in the world.

The Curriculum and Community Enterprise for Restoration Science (CCERS) Project, contains all of the components needed for a rich and engaging field station experience in the AP Environmental Science course. Centered on the restoration of the oyster population in New York Harbor, the Billion Oyster Project is based on authentic, hands-on STEM education which is helping to bring a resurgence to one of the richest estuaries in the world. Once known as the "Oyster Capital of the World", New York Harbor contained over 220,000 oyster beds and hosted an overabundance of aquatics species and birds when Henry Hudson arrived in 1609. Through the centuries since, the growth in population coupled with the Industrial Revolution and lack of conservation laws created a lethal environment for most of the wildlife but especially the Eastern oyster (*Crassostrea virginica*). By the 1820's most of the New York beds had been overharvested and could not keep up with the growing demands for the New York oyster. (Note 6) Finally, in 1927, the City Health Commissioner closed any of the remaining oyster beds.

The Billion Oyster Project serves many functions although two have immeasurable benefits and impacts – the restoration of the estuary and the education of the students. In addition to providing a conduit to the rejuvenation of the once vibrant harbor, the use of the curriculum is helping to ensure that the marginalized students in the five boroughs of New York City are exposed to the skills needed for the 21st Century.

A major component of the student curriculum is composed of the protocols that are used to create, study and nurture the Oyster Restoration Stations (ORS) that are currently peppering the New York City Harbor. Protocols have been created to provide historical background about the harbor and the oyster industry, to clearly outline expectations for the students about the Oyster Restoration Stations and their care and to provide guidance for the use of the tools and instrumentations needed to conduct authentic research in the field stations. The use of field stations to heighten the AP Environmental Science coursework, especially for underrepresented students has been endorsed by the National Research Council. To advance active learning and promote diversity in the sciences, field stations allow for opportunities that both promote the 21st Century soft skills and allow for real world experimentation and exploration. By the very nature of their informal setting and connection to nature, field stations and marine laboratories provide students with endless educational opportunities and collaborations.

Initially designed as an intermediate level science course offering with components in mathematics, social studies, history and geology, the extent of the lessons and field protocols in the Billion Oyster curriculum has grown almost exponentially in terms of its appeal to a variety of grade levels. The Billion Oyster Program has been in existence in New York City since its inception in 2014. Funded by a National Science Foundation Grant (#1440869), the project now engages fifty-four (54) New York City public schools with a total of 3,000 students participating in the program – thousands of students who are experiencing education through connections to their community and to nature. As stated by David Sobel (2005), place-based education enhances a students' appreciation for the natural world as well as increasing academic achievement.

The units in the curriculum fall into two broad areas: investigations and protocols. The investigations are experiences which give the students the STEM-based context needed to understand the history, chemistry and geography of the harbor and its surroundings. The protocols are the authentic field work explorations that allow the students to delve into the working of the harbor and its inhabitants with particular emphasis on the oysters and their ability to filter the estuary waters. Some examples of the investigations include the New York Harbor Populations Investigation and the Nitrogen Cycle Investigation. Similarly, examples of protocols include New York's Urban Ecosystem and particulate Water Testing.

Because sustainability is such a transdisciplinary field, the accompanying curriculum must encompass a plethora of content and accompanying skills. Education then, is the conduit for sustainable development. Education will provide the 21st century skills to arm the learners to meet their needs and the needs of future generations. By shifting the mindset of skills, it can be seen that 21st Century skills are those that are fluid and transferable. As stated by Alison Anderson (2013), thinking critically, solving problems, collaborating and managing risks and uncertainty are core competencies that are critical for employment in a green economy and living together peacefully in a sustainable society.

A tangible example of the overlap between the Billion Oyster Project curriculum and the 21st Century skills needed for success can be found in the lesson, "Extension Activities for the Field" which can be found in the Unit for Protocol 1: New York's Urban Ecosystem. Each of the activities in the lesson are designed to complement the work

that is done directly to the Oyster Restoration Station. Content areas include English language arts, mathematics, science, geology and geography. The lesson follows the first step of the 5E model of pedagogical delivery: Explore.

Students are asked to take a sample of the sediment and make observations using a field microscope, map and photograph the site conditions, log their observations and inferences in their naturalist journal, deploy traps and study crustacean anatomy, interview site users such as fishermen and park visitors and design an original experiment complete with hypothesis, procedures and research methods. The final stage of the investigation for this lesson is to share findings with their peers and the larger scientific community. This is done through their research papers as well as through a poster session which is held on Governors' Island each spring.

If we readdress the Seven Survival Skills put forth by Tony Wagner in the book, *The Global Achievement Gap*, we can align each of these activities and see that they mirror the skills outlined. By studying the environmental site and its inhabitants, collaborating on an authentic, related research topic, developing research methods and procedures for the study and sharing the findings through written and oral communication with the community, the students who are a part of the Billion Oyster Project have been given the opportunity to utilize the 21st Century Skills that are seen as essential building blocks for an holistic education. It is important to note that students will need these universal skills for more than economic reasons. These skills will also be relevant in the sustainability and growth of the planet by the next generation of citizens.

4. Conclusion

Neighborhood restoration is an area that is being developed as a viable educational and occupational option in the 21st Century and the Curriculum and Community Enterprise for Restoration Science Project is a conduit to this option. The word neighborhood has broad implications as the world “shrinks” in terms of connectivity and access. In this instance, the neighborhood is New York City and the participants are the marginalized populations in our education system. Synergy is being created through the union of the CCERs and the A.P. Environmental course being taught in New York City high schools. Currently, the mean score for students of color on the A.P. Environmental Science Assessment hovers around 1.5. As compared to other ethnicities such as White (3.2) and Asian (2.8), more inclusive measures, such as availability, relatability and the ability to make stronger ties to community must be addressed. Currently, the environmental citizenship level of students is considered moderate (Meerah, Halim & Naderson, 2010). To increase this level of commitment from all students, awareness, knowledge and commitment must be attained. The educator sector can play a vital role in teaching pertinent skills for the successful revitalization of a sustainable planet. Anderson (2012) champions the teaching and learning of 21st Century skills as they relate to integrating environmental education, scientific literacy and education for sustainable lifestyles. The Curriculum and Community Enterprise for Restoration Science is the agent of change that is needed to unite the education of our future generations with the rationale, 21st Century skills and the motivation to value and respect our planet.

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Notes

Note 1. Plessy v. Ferguson Supreme Court decision of 1896; overturned by Brown v. Board of Education Supreme Court decision of 1954.

Note 2. <http://schools.nyc.gov/Offices/mediarelations/NewsandSpeeches/2015-2016/Equity+and+Excellence.htm>

Note 3. United States Census Bureau (2016) https://factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml

Note 4. Citizens' Committee for Children of New York, 2016 <http://www.cccnewyork.org/blog/understanding-diversity-in-nyc-public-schools/>

Note 5. Total number of AP courses added to NYC high schools

Note 6. Kurlansky, M. (2007) *The Big Oyster: History on the Half Shell*, Random House, New York, New York