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Authentic Community Based Learning in New York City: An Holistic Model using the Billion Oyster Project and Curriculum and Community Enterprise for Restoration Science

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"An environment-based education movement--at all levels of education--will help students realize that school isn't supposed to be a polite form of incarceration, but a portal to the wider world." [1]

Constructivism and the Billion Oyster Project

Educators continue to seek the elusive silver bullet when trying to determine what will work for their students. Regardless of the setting – urban or rural, elite or poverty stricken, mainstream, self-contained or CTT, traditional or progressive, the main goal of the educator is to grab the students' attention with content that is relevant, vital and situated in the students' realm of interest. Each of the educational philosophers has their unique spin on what drives learning but many point to the real-world position of the germane connection known as constructivism. Dewey, Piaget, Vygotsky, Montessori and Bruner all toted the idea that children learn, or construct their knowledge, by internalizing experiences in their lives and making meaning from these experiences. The child's previous body of knowledge helps to shape the new information into palpable meaning that can be cognitively digested.

So where does this previous knowledge derive? Learning is a topic that is almost inexhaustible and far broader that this paper can do justice to, but knowledge does begin with the familiar. In Melaville, Berg and Blank's *Community Based Learning* (2001) there is a statement that says, "Education must connect subject matter with the places where students live and the issues that affect us all". Learning, just by its nature, begins within the home environment and then extends to the larger community in which the child is situated. Each home is distinctively unique but as the child moves to the larger community of neighborhood, where many have the same, shared learning environment. This shared environment is one, which can be the basis for learning experiences that will help in the social, emotional and intellectual development of the children within it. The notion of connecting the subject matter in schools to the places where students live opens a plethora of opportunities for learning. "Community" has many different configurations and can look different in almost all places, but it is the community where students learn to be citizens and learn to become stewards of the environment in which they live. Key to this understanding of situated learning is, among other content, the understanding the science and mathematics that surround the students. Knowledge of the working of the world around them helps to rouse both interest and concern, by harnessing their natural interest in where and how they live and by using their own community as a source of learning and action.[2]

A model that exemplifies the constructivist approach to learning by connecting the students with their community is the Billion Oyster Project which has been established in New York City. This place-based learning model is multidisciplinary, experiential and is situated in a community that is home to 8.5 million humans and countless numbers of aquatic and other terrestrial organisms. As its name implies, the focus of the Billion Oyster Program is to introduce a billion oysters back into New York Harbor. A Herculean endeavor in and of itself but then couple this with the connections to the citizens of the city of New York and the educational goals it has created and the extensiveness of the project can be realized.

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[1]Louv, R.(2005) Last Child in the Woods: Saving Our Children from Nature-Deficit Disorder; Algonquin Books, New York; NYhttp://richardlouv.com/

[2]Melaville, A., Berg, A.C., Blank, M.J. Community Based Learning: Engaging Students for Success and Citizenship,

Need: Environmental and Educational

New York harbor is arguable the world's best natural harbor. It is surrounded by the five boroughs of New York City with the shore of New Jersey to the west. Once inhabited by the Lenape people, its potential was not lost on the invasion of European explorers from Giovanni da Verrazano in 1524 to Henry Hudson in 1609. Once established as a colony, the city of New Amsterdam under the Dutch settlers grew rapidly as did its enviable commercial and economic possibilities. An estuary, New York harbor hosted an overabundance of aquatic species and birds, including the Eastern oyster (*Crassostrea virginica*). So abundant were the oyster beds, it is said that Henry Hudson had to navigate the Half Moon around the over 220,000 oyster reefs in the harbor. A staple of the Lenape diet, they soon became a favorite of the Dutch inhabitants and were eaten roasted, raw, boiled and fried. Moreover, although the Lenape used the shells to create tools such as knives and spearheads and for trade, the European settlers saw little use and routinely burned the shells.

New Amsterdam became New York in 1664 when the English understood the great potential for this port city. Initially founded for its abundance of beaver by the Dutch West India Company, New York was seen as the gateway to the inner continent and grew exponentially throughout the 17th and 18th centuries. The population of 110 original European settlers quickly expanded with waves of immigrants teeming into New York City. In 1760, the population rose to 18,000 and New York became the second largest city in America behind Boston and fifty years later was the largest city in the United States with 202,589 residents. These additions to the populace placed a great stress on the infrastructure of the city. With no laws of conservation or thought of the consequences of overuse of the natural resources, indigenous species that once thrived, such as the beaver and the oyster, were now reduced to the point of near eradication.

The oyster became a gastronomic phenomenon during the 18th and early 19th centuries in New York City. The combination of having reputably the best oysters in the world in what had become arguably the greatest port in the world made New York City for an entire century, the world's oyster capital. The only question now was whether there were enough oysters to feed the world. An inversely proportional relationship began to develop between the expanding New York City human population and the dwindling natural resources. Oysters had the unfortunate and lethal combination – they were inexpensive, plentiful and accessible. Every New Yorker had access to oysters and their consumption. By the 1830's places called "oyster houses" sprinkled the downtown area. For as little as 6¢, all you can eat oysters filled the menus of oyster houses that were open for most of the day and night. Additionally, saloons, food carts and home consumption of oysters was prevalent. Higher scale eating establishments also served the oyster at not so modest a price. Downing's at Wall Street and Broad Street and Delmonico's at the intersection of Beaver, William and South William Streets became world-renowned culinary institutions of the time relying heavily on the oyster as one of their main staples. At its peak, approximately 765 million oysters passed through "Oyster Row".[3] Pearl Street in the heart of downtown New York was once paved with the shells of oysters, hence the name.

As early as 1791, a ruling stated that anyone taking oysters in Jamaica Bay had to pay the town of Rockaway one shilling for every thousand oysters. In 1810, the oyster beds of Staten Island were showing signs of exhaustion. By the 1820's most New York beds had been overharvested and could not keep up with the growing demands for the New York oyster.[4] Rivalries over fishing beds called the "Oyster Wars" developed and lasted for decades. Pollution and over-harvesting coupled with outbreaks of typhoid fever and cholera finally took its toll. In 1927, the City Health Commissioner closed the remaining oyster beds in New York Harbor. "Ecosystem engineers" is the term used by New York Harbor Foundation President, Murray Fisher to describe oysters. By filtering the waters of New York Harbor, oysters provided a prolific environment for other marine species to inhabit the estuary. Once the oyster population declines to the point of eradication, so too, did the ability of the harbor to support the other aquatic life in a protective habitat. A need for the Billion Oyster Project is evident and would suggest long overdue environmentally speaking. A need also exists in terms of the population of New York City. Not only are we in need of a revitalized New York harbor, we are also in need of a citizenry that will have learned from our past mistakes and build on an environmentally conscience appreciation of our natural gifts. Through citizen science and stewardship, the children of New York City are becoming stakeholders in this endeavor. Students in the New York City public school system are in need of a stronger connection between the natural world and the classroom setting.

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[3] Museum of the City of New York blog, https://blog.mcny.org/2012/10/16/oysters-from-rags-to-riches/

[4] Kurlansky, M. (2007) The Big Oyster: History on the Half Shell, Random House, New York, New York

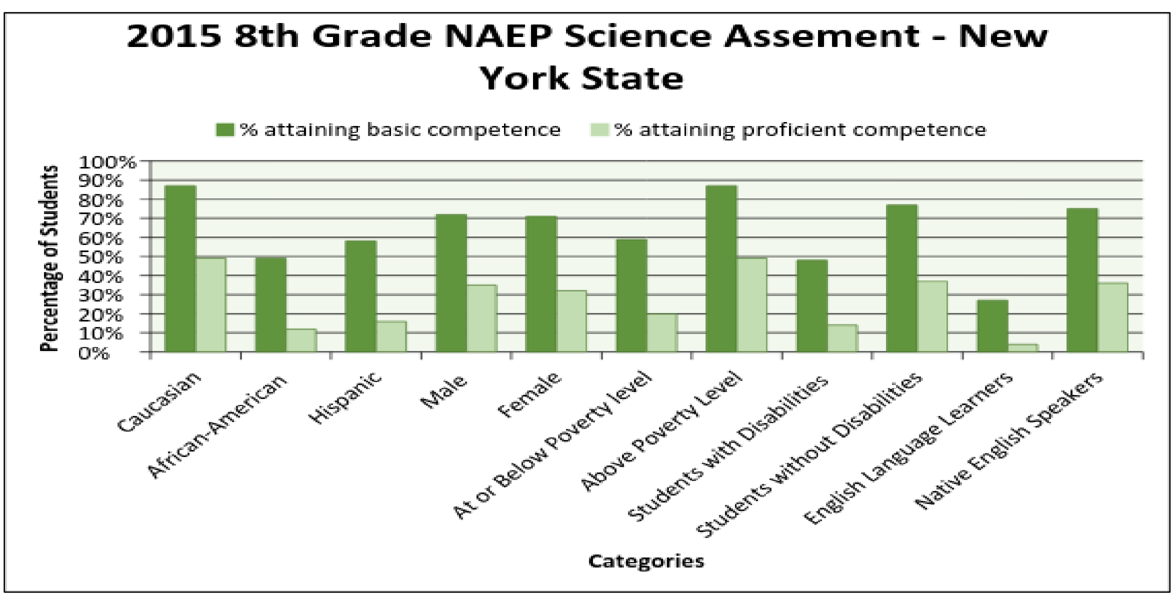
The New York City Department of Education is a behemoth institution. It educates 1.1 million students in over 1600 schools within the five boroughs. Encompassed within its 1.1 million students are students with disabilities (18.7%), Non-English Language students (12.5%) and minority students (68%). The total number of students living at or below poverty is 76.5%, or 841,500 children. Connecting school to community has been a well-researched and documented area of education. Science is considered one of the content areas that is persistently onerous to students. This can be attributed to a number of factors including curriculum, setting and interest level. Lack of interest in science can be observed as early as middle school and continues in science classes at the high school level and beyond (Hagay & Baram-Tsabari, 2015). Students who feel marginalized in the traditional educational setting respond far better with non-traditional options. Project-based learning is one of the more effective methods used to facilitate student learning. As stated in Project-Based Instruction: A Review of the Literature on Effectiveness, "Research clearly indicates that project-based learning is beneficial, with positive outcomes including increases in level of student engagement, heightened interest in content, more robust development of problem-solving strategies, and greater depth of learning and transfer of skills to new situations". (Holm, 2011). The fact that project-based learning is a powerful motivational tool for all students is evident but research has also shown that it has an even greater effect on underrepresented students in the fields of STEM (Science, Technology, Engineering and Mathematics). Statistically, underrepresented students have underperformed on the national science assessment as indicated in the table below:

Table 1. NAEP 8th Grade Science Assessment – New York State Results (2015)

Categories	% attaining basic competence*	% attaining proficient competence*
Caucasian	87%	49%
African-American	49%	12%
Hispanic	58%	16%
Male	72%	35%
Female	71%	32%
At or Below Poverty level	59%	20%
Above Poverty Level	87%	49%
Students with Disabilities	48%	14%
Students without Disabilities	77%	37%
English Language Learners	27%	4%
Native English Speakers	75%	36%

*The NAEP Science Achievement Levels – Basic (Score of 131) and Proficient (Score of 167)https://nces.ed.gov/nationsreportcard/science/achieveall.aspx

Graph 1. NAEP 8th Grade Science Assessment – New York State (2015)



Clearly, the traditional method of teaching science has not achieved its purpose for all students. There is a need to close the achievement gap on several levels. 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) To this end, community-based science education would seem to be an excellent choice to ameliorate the situation. Community-based educational opportunities come in a variety of forms. As defined by the National Research Council[5], community-based learning has been categorized in the following entities:

1. Academically Based Community Service – connects the academic mission of colleges and universities with the aspirations of the communities around them.
2. Civic Education – aims to prepare competent and responsible citizens.
3. Environmental Education – uses the school's surroundings and the community as its framework within which the students construct their own learning[6]
4. Placed-Based Learning – uses the unique history, environment, culture and economy of a particular place.
5. Service Learning – integrates community service with academics
6. Work-Based Learning – allows young people to spend time with adults as in mentoring

Given the parameters of these classifications, the CCERS project fulfills each of the above categories at some level for the students and teachers in the project.

Filling the Need Big Apple Style

The "Curriculum and Community Enterprise for Restoration Science" is a National Science Foundation Grant-funded opportunity that became available to the New York City community on October 1, 2014. As with any successful model of educational value, the conceptual framework of the CCER Project is both multi-layered and well-articulated. Five interrelated components create a synergy of learning for all of the stakeholders. Since the project is situated in New York City, there is no shortage of viable partnerships that have been formed. These include Pace University, the Columbia University Lamont-Doherty Earth Observatory, the New York Academy of Sciences, the New York Harbor Foundation, the New York Aquarium, the River Project, Good Shepherd Services, the University of Maryland's Center for Environmental Sciences, and the New York City Department of Education. The model relies heavily on the interactions between and among its partners as well as the larger New York City Harbor and its inhabitants – both aquatic and human.

Creating a Foundation for Learning

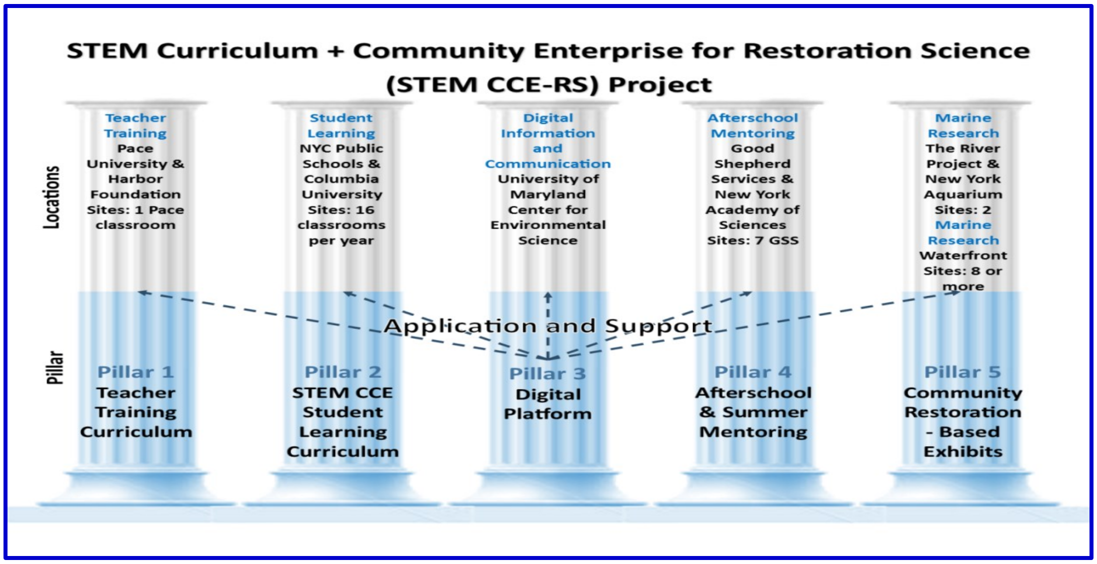
The STEM Curriculum and Community Enterprise for Restoration Science, or (STEM-CCE-RS) Project program has been built on five explicit and well-defined pillars. The construction of the program was orchestrated in the following sequence:

1. A Teacher Training Curriculum
2. A Student Learning Curriculum
3. A Digital Platform for Project Resources
4. An After-school and Summer STEM mentoring Program
5. Community Restoration Based Exhibits

[5]Melaville, A., Berg, A.C. & Blank, M.J. (2006) Community Based Learning: Engaging Students for Success and Citizenship

[6]Lieberman & Hoody, Closing the Achievement Gap: Using the Environment as an Integrating Context for Learning

Diagram 1. The five pillars of the STEM Curriculum & Community Enterprise for Restoration Science (STEM CCE-RS) Project



PILLAR I: Teacher Training Curriculum

As with any major educational initiative, many components must be in place to both create a synergy for the project and to ensure its sustainability. The Teacher Education component of the project takes place at Pace University, a private institution with its main campus located in the heart of downtown Manhattan. Dr. Lauren Birney, an Associate Professor in the School of Education, has carefully constructed the coursework for the participating teachers in the program. The CCERS Fellowship at Pace is a two-year professional development program that trains teachers to engage their students in hands-on environmental STEM and restoration ecology in New York Harbor. The Fellowship is open to NYC Department of Education middle school teachers working in Title I funded schools. Classes and trainings are taught by guest experts, scientists from Columbia's Lamont Doherty Earth Observatory, curriculum specialists from New York Harbor Foundation, and partner organizations such as The River Project. Professional Development sessions are divided into three main categories and are either two-hour after school sessions or all day Saturday sessions for the participating teachers. A sample of the offerings can be found in Table 2. The professional learning experiences for the teachers are a fundamental and vital piece of the project. The teachers not only gain invaluable knowledge and experience pertaining to the work that they will share with their students but they also form a community of adult learners. Their collaboration is critical as some of the teachers may be the only representative from their particular school.

Table 2. Professional Learning Sessions

Type of Session	Name of Session	Duration of Session
Professional Development	Critters at the River Project	2 hours – after-school
Scientist Workshop	Estuarine Hydrology	2 hours – after-school
Oyster Restoration Basic Training	ORS Basic Training	7 hours – NYC PD Day
Other Symposium	3rd Annual BOP Symposium	5 hours - celebration

PILLAR II: Student Learning Curriculum

The student-learning curriculum is similar to the teacher education pillar in that it is intended to build a repository of educational experiences for the students in the NYC public school system[7]. There are two components to building this curriculum and they were created in unison by the curriculum writing team.

[7]There are private schools that use the resources created for the BOP-CCERS Project but due to the parameters of the NSF grant, their data cannot be included in the official evaluation of the project.

One component is comprised of the lessons that are written for the middle school science classes was concerned with the standards imposed by both the New York State Department of Education and the New York City Department of Education. Because "add-on" lessons, or lessons that do not fit any of the curriculum mandates for New York State, are difficult to incorporate in the school year.

A major reason is the lack of time for new curriculum in a schedule that is precisely measured. Each of the subject areas must meet the mandated 40 minutes a day for instruction (or 180 minutes a week) as per Part 100.1 Regulations, NYSED. http://www.p12.nysed.gov/part100/pages/1001.html. Since there is a large number of subject areas to cover each school day. The reality is that an "add-on" would not be taught consistently and become meaningless in terms of curriculum. For this reason, the BOP curriculum began with the obvious content area of science. Since the major component of the project is the restoration of oyster beds to New York Harbor, life science became the nucleus of the classroom science curriculum. Problematic to the development of the science curriculum for intermediate grades six through eight was the fact that the content had to address the specific New York State Intermediate Science Standards as well as adhering to the New York City sequence of these standards.

In 2008, the New York City Department of Teaching & Learning had initiated a Science Incentive for Grade K through eight. This incentive included a spiraled approach to the elementary and middle school science courses. Rather than teaching discrete bundles of content specific science, each grade level would have several science content areas taught throughout the year. These bundles of specific science content would build on the previous year's content so that the content is presented in a vertical layering of the information. A curriculum map was designed to fit these parameters and introduce the Billion Oyster content. An example of the interlacing of the standards, sequencing and Billion Oyster content is found on Table 3.

Table 3. Sample of the BOP Science Classroom Curriculum Map for NYC (Grades 6-8)

GRADE 6	Unit 1: Energy and Simple Machines	Unit 2: Weather and the Atmosphere	Unit 3: Diversity of Life	Unit 4: Interdependence
	BOP: How do we get around? (Transportation in the NYC Harbor)	BOP: Is it fair, How we share the air?	BOP: Why is life only found in biological communities? Why is it that nothing lives alone?	
GRADE 7	Unit 1: Geology	Unit 2: Energy and Matter	Unit 3: Dynamic Equilibrium: The Human Animal	Unit 4: Dynamic Equilibrium: Other Organisms
	BOP: Why is New York City here?	BOP: Why is it okay to dump some things in the water but not others?	BOP: Why are humans on the top (of New York City's marine food webs)?	
GRADE 8	Unit 1: Reproduction, Heredity and Evolution	Unit 2: Forces and Motion on Earth	Unit 3: The Sun, Earth and Moon system	Unit 4: Human and the Environment: Needs and Tradeoffs
	BOP: Will New Yorkers always look so diverse?	BOP: How else could we get around?	BOP: Why is there life on Earth and when will, it end.	BOP: Should we keep building New York City or eventually move away?

The second stage of creating the students' curriculum is also housed on at the virtual platform for the Billion Oyster Project and is subject to the same use and scrutiny. Arguably, this is the more creative and pertinent pieces of the curriculum for the project. This curriculum contains both classroom lessons and field protocols for the students and teachers.

Table 4. Sample of BOP Field Protocols & Classroom Lessons

Protocol	Lesson	Grade – Unit	NYSED Standards – Key Ideas
New York's Urban Ecosystem	A New York City Water Cycle	Grade 6 – Unit 2 Weather & Atmosphere	PS Key Idea 4 - Energy exists in many forms, and when these forms change energy is conserved.
Oysters	Density and Oysters	Grade 7 – Dynamic Equilibrium in Other Organisms	LE Key Idea 1 - Living things are both similar to and different from each other and from nonliving things.
Water Quality	Dissolved Oxygen and Oysters	Grade 8, Unit 4 - Humans and the Environment: Needs and Tradeoffs	LE Key Idea 7 - Human decisions and activities have had a profound impact on the physical and living environment
Nitrogen Cycle Investigation	Neighborhood Nitrogen Mapping	Grade 6, Unit 4 - Interdependence	LE Key Idea 6 - Plants and animals depend on each other and their physical environment.

As with most of the STEM Curriculum & Community Enterprise for Restoration Science (STEM CCE-RS) Project or Billion Oyster Project, this component is a work in progress. Teachers and BOP curriculum developers can access the units and lessons from the virtual platform to use in the classroom and make revisions, adaptations and further develop the lessons for the various stakeholders in the project. During the process of creating the curriculum, it became quite apparent that to remain faithful to the vision for the project, the content had to go beyond just science content. To be able to offer a place-based, environmental education, multiple content areas such as mathematics, history, geography and language arts had to also be included. Engaging students in transdisciplinary learning has the ability to allow knowledge to be constructed through hands-on, real world experiences by both the teacher and the students. The context for this engagement then becomes the local community, in this case, New York Harbor and the surrounding environment. Students experience higher levels of engagement and take a deeper approach to learning when they are able to apply what they are studying to address a real-world problem (Lombardi, 2007).

A shift in the writing evolved as the thematic approach of non-compartmentalized instruction was seen as the most realistic option. It was concluded that a transdisciplinary approach be taken when writing the intermediate lessons. Although interdisciplinary involves two or more academic disciplines, transdisciplinary takes this a step further and situates the learning in an authentic real world setting where the disciplines are not just learned side by side but become integrated. As defined by the International Bureau of Education, transdisciplinary approach to education is an approach to curriculum integration, which dissolves the boundaries between the conventional disciplines and organizes teaching and learning around the construction of meaning in the context of real-world problems or themes.[8] A good example of the transdisciplinary approach is the lesson titled, "Extension Activities for the Field". This lesson is composed of a series of short activities designed to complement the Oyster Restoration Station (ORS) monitoring expeditions. The activities can be linked to ELA, Mathematics, Science and Social Studies content areas. As with all of the lessons in the platform repository, the five "E"s instructional model[9] is the framework used for the lesson development. This model is based on the constructivist approach to learning which matches the BOP philosophy. The ELA segments of the lessons involve observing the site including benthic soil samples, trees and animals in the area of the ORS through mapping and making entries in their naturalist journal. Science and mathematics activities include taking measurements and studying the anatomy of mobile crustaceans. Social studies activities include journal entries about the historical development of the area during its succession. In addition to transdisciplinary lessons, there are also those that are cross-disciplinary, such as the meshing of science and social studies in "Oyster Decline in New York Harbor" and single disciplinary lessons such as "Nitrogen Cycle Pollution".

This wide-ranging approach to the curriculum allows for both flexibility and depth of knowledge is a number of content areas.

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[8] International Bureau of Education, Geneva, Switzerland, http://www.ibe.unesco.org
[9] The 5 E's, Enhancing Education, http://enhancinged.wgbh.org/research/eeeee.html

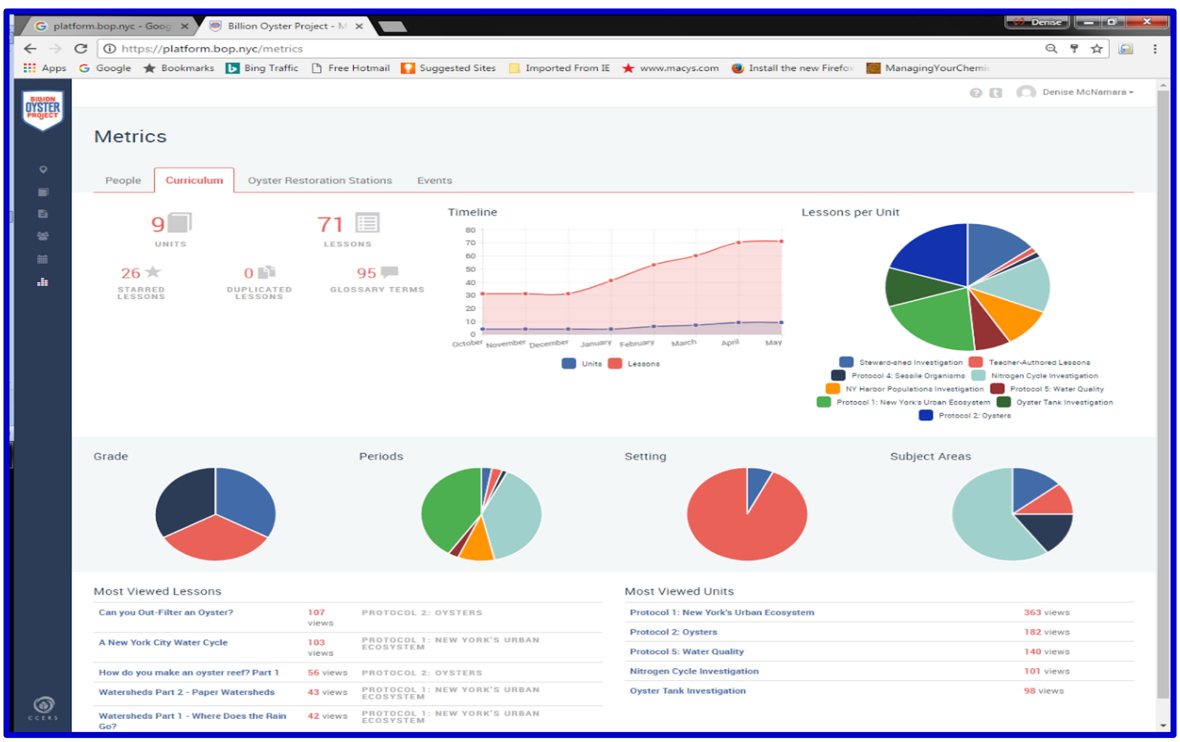
PILLAR III: Digital Platform for Project Resources

The digital platform serves a multitude of purposes and is another integral part of the STEM Curriculum and Community Enterprise for Restoration Science, or (STEM-CCE-RS) Project. As with all of the pillars, this is a dynamic component. General access to the site is open to all of the stakeholders as well as the public and selected sections such as curriculum access are reserved for the educators in the program. The platform is divided into six sections:

1. Restoration – containing the dashboard, expeditions, location of the Oyster Restoration sites and the data that is being collected
2. Curriculum – containing the library, units/lessons and glossary
3. Research – containing publications and posters
4. Community – containing "my profile, teams, organizations and people
5. Events – posting of all of the events involved in the project
6. Metrics – contains statistical data on the community, curriculum, restoration and events

One of the central elements of the digital platform is the University of Maryland Center for Environmental Science, which is responsible for maintaining and updating the platform portal. Future additions include but are not limited to developing a students' dashboard to allow for individual charting of progress and a citizen science section to benefit the entire scientific community. All of the facets of this pillar ensure a comprehensivenexus that allows for numerous touch points for all of the stakeholders as well as the general public

Diagram 2. Sample Metric Section from the BOP Platform (www.http://platform.bop.nyc/) to



PILLAR IV: After-school and Summer Mentoring Program

This pillar of the program is another integral component focused on ensuring continuity of both instructional knowledge and engagement of the students. The combined efforts of the New York Academy of Science and Good Shepard Services of New York are at work to guarantee that the students in the program have a place to go in the after-school hours and summer months. Focus is on the students in low-income neighborhoods who would benefit from the extended instructional time away from the classroom. Focusing on invertebrate zoology, the students come to a better understanding of the diverse aquatic populations in their community and are better able to see the long-term effects of their efforts during the school year.

As reported in a study conducted by the Rand Corporation (2016), students with high attendance in summer programs have an academic advantage over their peers and were rated by teachers as having stronger social and emotional competencies as well.

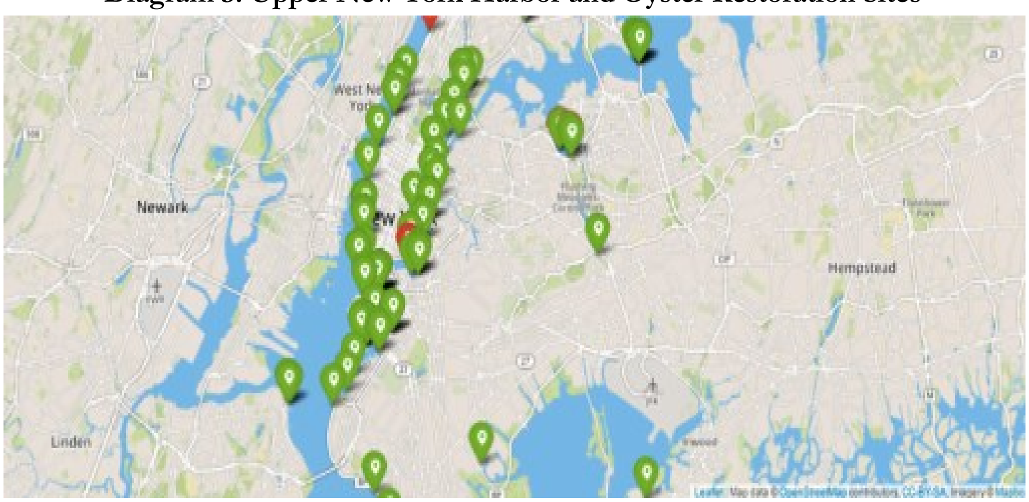
PILLAR V: Community/Museum Restoration-Based Exhibits

Pillar five is another collaborative effort by two of the partners in the STEM Curriculum & Community Enterprise for Restoration Science (STEM CCE-RS) Project. The River Project, a marine-science field station on the Hudson River and the New York Aquarium, located in Coney Island, Brooklyn are working together to create interactive exhibits that showcase the restoration efforts being employed to rejuvenate New York Harbor. Highlights of these exhibits will be the oyster restoration and the biodiversity found in the estuary called New York Harbor. Although these exhibits will be designed to allow for enhanced learning experiences for the students in the program, they will also be open to the public. Students and teachers will benefit from the field trips to the exhibit sites and the general public will come away with a heightened understanding of the crucial work being done to restore one of the most important waterways in the world.

INITIAL RESULTS: Through the eyes of the participants

When discussing interest and employment in STEM fields, there is aninterminable lack of diversity. According to U.S. Census Bureau projections, racial and ethnic minorities are expected to comprise more than half of the national population by 2050[10]. Minority students will make up an increasingly larger percentage of students in the national education system and STEM talent pool. Yet these students are among the least represented in STEM fields. As stated In *Cultural Studies in Science Education*, underrepresented and immigrant students are often at a greater risk of losing interest in science as there is the added cultural and linguistic disconnect between school and their life experiences. (Rahm, 2007).For this reason, place-based environmental education can engage students in local area science experiences. (Lim & Calabrese-Barton, 2006).The Curriculum & Community Enterprise for Restoration Science (STEM CCE-RS) Project is one of the most expansive efforts focused on place-based environmental education to be conducted in the school in New York City. Currently, over 3,000 students and teachers are involved in the program and this number has increased during each year of the grant's existence. An overwhelming majority of these students are classified as minority, low-income and immigrant. The project has given these marginalized students the opportunity to become involved in their neighborhood community and create an impact that can be felt in the larger environmental community of New York Harbor. They are working alongside scientists, educators, technicians and restaurateurs to not only get a sense of the intricate intertwining of these careers but also to understand the possibilities that are available to them. Students learn how to interact with adults and organizations, are exposed to workplaces and adult jobs, and can develop potential career interests(Larmer, et al, 2015).

Diagram 3. Upper New York Harbor and Oyster Restoration Sites



As noted in the external evaluator's report to the National Science Foundation, the teachers strongly agreed that the teacher fellowship course helped increase their content knowledge feel most confident in collecting field

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[10]https://www.census.gov/population/projections/files/analytical-document09.pdf

research data and facilitating the students' use of research tools and instruments in the field.[11]In the same report, the students stated that they like to see how things are made and felt most confident in their ability to use science equipment correctly. Students also believe that scientists make a meaningful difference in the world but have some skepticism about becoming scientists themselves. This is where the Billion Oyster Project can make significant headway. By intervening in the education of the marginalized students of New York City, the project can spark aninterest by tapping into the inherent curiosity about one's surroundings. The wonders of New York Harbor with its limitless ability to educate and its need for nurturing and care provides the setting for student involvement and future career opportunities. An ethnographic study of a participating school allows the outsider to get a conspectus of the project. Interviews were conducted with a participating teacher and her direct supervisor. The school is an ethnically diverse public high school consisting of 74% minority students including 6% English Language Learners and 19% students with disabilities. The percentage of students who are considered at the poverty level is 74% of the student population or 1893 students. Student participants of the Billion Oyster Project are working the curriculum through their

Advanced Placement Environmental class. At the end of the school year, these 28 students, who are representative of the overall student body, sat for the A.P. Environmental examination given by the College Board in the hopes of earning college credit while in high school. As shared by the classroom teacher, the students in her class are extremely enthusiastic about the inclusion of the BOP Curriculum and their Oyster Restoration Station. As a matter of fact, at the introduction of the BOP curriculum into the A.P. Environmental course, one student commented that he had no knowledge of what an estuary was or the fact that New York Harbor is considered to be one of the most vital tidal estuaries in the world. The relevance to the A.P. Environmental curriculum was seen to be a motivating factor once the teacher compare the A.P. Environmental Science Enduring Understandings the students needed to study and the Billion Oyster Project and Curriculum for Restoration Science. For example, the teacher focused much of the Advance Placement Environmental Science Enduring Understanding 5C - Human activities, including the use of resources, have physical, chemical and biological consequences for watersheds and aquatic systems, on the work that the students did to create and nurture their Oyster Restoration Site. Located in the Narrows Bay, the students conducted three expeditions to the site during the school year. Using the BOP digital Platform (Pillar III), they were able to enter their expedition data into the five protocol templates available and compare and contrast their data with other restoration sites. This gave the students a terrific sense of ownership and pride in contributing to a project that was so expansive as well as enriching their academic understanding of the impacts of discharges such as sewage, pesticides, industrial wastes and sediments on estuaries and coastal waters. Frankly, if the project did not exist, there would be a need to invent it. The initial results to the harbor in terms of biodiversity and water quality arestunning. (See Table 5).

Table 5. Results to Date: Billion Oyster Project by the Numbers

- Oysters grown in NY Harbor: 19.5 Million
- Reef area restored: 1.05 acres
- Pounds of shell reclaimed and recycled: 300,000
- Gallons of Water filtered so far – 19.7 trillion
- Pounds of Nitrogen removed from the water – 72,500 lbs.
- Number of restaurants engaged: 53
- Schools engaged: 54
- High school students engaged: 2,150
- Middle school students engaged: 875

Equally as important and of significance in the pedagogical world is the fact that thousands of students who might otherwise have been lost in the complexities of the educational system in New York City are experiencing education through connects to community and nature. Sobel's (2005) affirmation of this methodology states that this approach to education increases academic achievement, helps students develop stronger ties to their community enhances students' appreciation for the natural world and creates a heightened commitment to serving as active, contributing citizens.

References

Bouillion, L.M. & Gomez, L.M. (2001) Connecting School and Community with Science Learning: Real World problems and school-community partnerships as contextual scaffolds, *Journal of Research in Science Teaching*, Volume 38, Issue 8, pages 878-898.

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Basu, S.J. & Calabrese Barton, A. (2007) Developing a Sustained interest in science among urban minority youth, *Journal of Research in Science Teaching*, Volume 44, Issue 3, pages 466-489.

Calabrese Barton, A. & Berchini, C. (2013). Becoming an insider: Teaching science in urban settings. *Theory into Practice, 52*(1), 21-27.

Buxton, C. (2010). Social problem solving through science: An approach to critical place-based science teaching and learning. *Equity and Excellence in Education, 43,* 120-135.

Calabrese Barton, A. (2001) Science Education in Urban Settings: Seeking new ways of praxis through critical ethnography, *Journal of Research in Science Teaching*, Volume 38, Issue 8, pages 899-917.

Holm, M. (2011) Project-0Based Instruction: A Review of the Literature on Effectiveness in Prekindergarten through 12th Grade Classrooms, Rivier Academic Journal, Volume 7, Number 2

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

Larmer, J., Mergendoller, J. & Boss, S. (2015) Setting the Standard for Project Based Learning, ASCD, Alexandria, VA www.ascd.org

Lieberman, G. & Hoody, L. (1998). Closing the Achievement Gap: Using the Environment as an Integrating Context for Learning, San Diego, CA: State Environment and Education Roundtable

Lim, M. & Calabrese Barton, A. (2006) Science learning and a sense of place in an urban middle school, *Cultural Studies of Science Education*, 1, 107-142.

Lombardi, M. M. (2007). Authentic learning for the 21st century: An overview. *Educause learning initiative*, *1*(2007), 1-12. http://www.educause.edu/library/resources/authentic-learning-21st-century-overview

Melaville, A., Berg, A.C. & Blank, M.J. (2006) Community-Based Learning: Engaging Students for Success and Citizenship, The Coalition for Community Schools.

National Research Council. (2009) *Learning Science in Informal Environments: People, Places and Pursuits*. Committee on Learning Science in Informal Environments, Philip Bell, Bruce Lewenstein, Andrew W. Shouse and Michael A Feder, Editors. Board on Science Education, Center for Education, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press

Outwater, A. (1996) *Water: A Natural History*, Penguin Books Group, New York, NY

Rahm, J. (2008) Urban youths' hybrid positioning in science practice at the margin: A look inside a school-museum-scientist partnership project and an after school science program, *Cultural Studies of Science Education*, 3, 97-121.

Rand Corporation, Summer Learning programs can benefit low-income students, study finds, *Science Daily*, 9/7/2016, https://www.sciencedaily.com/releases/2016/09/160907125115.htm

Sobel, D. (2005) *Place-based education: Connecting classrooms and communities*. Great Barrington, MA: The Orion Society.