"Environmental Literacy for All": High School Environmental Education in California

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ABSTRACT

Increasing environmental literacy within our population is crucial for the development of effective solutions to current and future environmental problems. Environmental literacy describes an individual's environmental knowledge and concern emphasizing their ability to act and make decisions in an environmentally conscious manner. A formal, K-12 environmental education (EE) is one powerful avenue to foster environmental literacy in our youth. However, not all students have access to such an education. This research examined the access that high school students in low socioeconomic communities have to environmental education and barriers for its implementation through case studies of two high schools, Richmond High and Soledad High. Richmond is in an urban area, while Soledad is in a semi-rural area. Interviews with teachers revealed that students at these schools have limited access to environmental curriculum. In addition, emphasis and prioritization of meeting state standards, within course curriculum and on a school-wide level, appeared to be the most significant limiting factor of environmental education at Richmond High school and Soledad High school. Despite location differences, challenges discussed by teachers were very similar. Other important barriers highlighted by teachers were lack of funding, student difficulties with learning and lack of access to green space. This research highlights the inequity of access to quality environmental curriculum for high school students in People of color (POC) and low-income communities and the severe need for increased priority of expanding environmental education in these communities.

KEYWORDS

urban education, K-12 education, environmental curriculum, equity of access, low-income school, environmental knowledge

INTRODUCTION

Effective environmental education is vital for addressing the rapid progression of climate change and other environmental threats (NCSE 2008). Public opinion and knowledge can have a significant influence on the passage of environmental policy (Anderson et al. 2017). However, many Americans do not truly understand environmental issues or topics (Robelia and Murphy 2011). U.S. studies continuously report low levels of environmental knowledge within the American population. In 2010, a survey testing public knowledge about climate change revealed that 52% of Americans scored the equivalent of an F, and only 8% scored the equivalent of an A (Leiserowitz 2010). Without adequate knowledge, people may inadvertently favor policies that yield outcomes they do not intend nor desire (Sterman and Sweeny 2007). Moreover, future environmental problems are expected to only increase in complexity, highlighting the need to increase environmental knowledge within the population. Individuals must be able to make informed decisions regarding environmental policies and strategies. This paper argues there is a need to build environmental literacy, especially within our teenage youth.

While environmental education in the United States is still not widespread, environmental education initiatives have grown over the past decade to create a more informed citizenry; however, issues of equity have arisen surrounding access to K-12 environmental education that builds environmental literacy. In 2015, a report by the California Department of Education highlighted that there is a gap in students who do and do not have access to environmental education, largely due to inequities in financial, personnel and curricular resources (ELTF 2015). Actual implementation of environmental curriculum is highly dependent on local communities and the resources available to them. Historically, issues of education inequities are most prominent in low-income communities and communities of color. As a result, not all K-12 students have access to quality environmental education and may lack things such as quality teachers or instructional resources.

Although environmental education that builds environmental literacy is beneficial for all K-12 students, it is especially important for high school students. High school students are the future generation that will be faced with the task of remedying environmental issues caused by previous generations. However, like the rest of the American population, surveys of high school students also report low levels of environmental knowledge, or what is known as “environmental

literacy", which is alarming because many students will not receive any more formal education once they graduate from high school (Gambro and Switzky 1996). This means for some students' high school is one of their last opportunities to receive a formal environmental education.

POC and low-income students experience even lower rates of attaining a higher education. Additionally, they are also underrepresented within both science and environmental fields. Providing POC and low-income youth with high school environmental education can help motivate and prepare them to pursue a higher education in these fields. However, high schools that serve students of color or low-income students typically have less and lower-quality academic classes and programs (Darling-Hammond 2004). This highlights the need to ensure there is equitable access to quality environmental education that builds environmental literacy for POC and low-income students. Furthermore, it is beneficial to examine the barriers in the implementation of such education in order to identify ways to work toward this goal.

This paper discusses the issue of equity of access to environmental education through two case studies that examine the access that high school students in low-socioeconomic communities have to effective environmental education. This research is guided by three questions: 1) what access do students have to environmental curriculum? 2) what are common barriers to the implementation of environmental curriculum? And 3) what are the motivating/limiting factors for the state of environmental education offered at these high schools? This paper argues that there is a severe issue in terms of access to quality environmental curriculum for high school students in these communities, and that there should be greater priority placed on expanding environmental education in POC and low-income communities.

Origins of Environmental Education

Early Influences

Early influences of environmental education (EE) can be tied back to the late nineteenth century. Disinger (1985) describes nature study, outdoor education and conservation education as the primary antecedents of EE. Popular during the late nineteenth century, the growth of nature study marked a period of increasing interest in human interactions with nature in the U.S. (Carter and Simmons 2010). Nature was viewed as something to conquer and tame. Then, entering the

twentieth century, growing concern over the use of natural resources led to the development of conservation education.

Conservation education significantly grew as problems arose in the U.S. regarding the misuse and overuse of natural resources. Conservation education focuses on educating people on the issues that arise from the mismanagement of natural resources. Moreover, greater attention was also put on the "wise use" of natural resources, and recognizing the impact of formal education, conservation education was implemented into state-level curricula (Disinger 1985). Today, conservation education still has a strong presence in contemporary environmental education (Carter and Simmons 2010).

Emphasis of conservation education also influenced the creation the National Park Service, as outdoor education was seen as a valuable tool for conservation. Unlike nature study and conservation education which are generally considered to be content areas, outdoor education is more often viewed as a teaching method (Carter and Simmons 2010). Disinger (1985) states that outdoor education is an important aspect of both nature study and conservation education. Outdoor education provides students with first-hand experiences with nature, which has been shown to improve environmental attitudes and intentions (Cheng and Monroe 2010). In fact, when environmental education is moved outdoors, students seem to experience more powerful, focused and memorable experiences (NEEF 2015).

Contemporary Environmental Education

Amid the environmental movement, environmental education emerged as a distinct field in the 1960's. The environmental movement was motivated by growing discourse and awareness of environmental problems, especially the overuse of DDT. In 1969, within the field of education, William B. Stapp critiqued conservation programs for mainly focusing on basic resources versus community environment and its associated problems. He stated there needed to be an educational approach that effectively educates man on their relationship with the total environment. As a result, Stapp then worked to write the first formal definition of environmental education.

In the "Concept of Environmental Education", Stapp defined environmental education as aimed at producing a citizenry that is knowledgeable of the biophysical environment and its associated problems, aware of how to help solve these problems, and motivated to work toward

their solution (Stapp et al. 1969). Stapp also established that for EE to reach its full potential of impact it should: 1) provide factual information of the biophysical environment that will increase individuals understanding of such, 2) develop a concern for environmental quality which will motivate individuals to work towards solutions to environmental issues, and 3) inform citizens on how to effectively achieve the goals that arise from their attitudes concern for the quality of the environment. Decades later, many EE scholars, organizations, and government entities still follow a similar framework of environmental education laid out by Stapp and his associates.

In the following years, EE gained international recognition. Concerned about transboundary pollution and acid rain, the 1972 United Nations Conference on the Human Environment, held in Stockholm Sweden, worked to "encourage and provide guidelines for action by governments and international organizations designed to protect and improve the human environment" (Brisman 2011). The conference resulted in what is known as the "Stockholm Declaration", where numerous recommendations are made to address global environmental issues. In recommendation 96, the conference proposed environmental education as a means of doing so. Alongside being the UN's first major conference on global environmental issues, the conference brought awareness to the need for environmental education (Carter and Simmons 2010).

Following the Stockholm Conference, the Belgrade Charter and Tbilisi Declaration also influenced the development of EE as we know it today. In 1975, the Belgrade Charter, written at the UNESCO-UNEP International Workshop on Environmental Education, presented a global framework and guiding principles for EE. Similar to Stapp's first definition of EE, the charter defined the goal of EE as:

> To develop a world population that is aware of, and concerned about, the environment and its associated problems, and which has the knowledge, skills, attitudes, motivations and commitment to work individually and collectively toward solutions of current problems and the prevention of new ones (p. 3).

The Belgrade Charter also defined that the principal audience of EE is the general public. Within this, it presents two major categories: the formal education sector and the non-formal education sector. Moreover, among its eight principles, the charter included that EE should emphasize active participation in preventing and solving environmental problems.

The Tbilisi Declaration is viewed as a foundational document in the field of EE. In 1977, it was created at the world's first intergovernmental conference on EE also organized by UNESCO-UNEP. Delegates of the conference built upon the Belgrade Charter to lay the framework, principles and guidelines for development of EE at local, national, regional and international levels. The Tbilisi Declaration details five categories of EE objectives: awareness, knowledge, attitudes, skills, and participation. According to the document, the objectives of EE are to help social groups and individuals: 1) acquire awareness and sensitivity to the total environment and its problems; 2) gain experience in, and basic understanding of, the environment and its problems; 3) acquire a set of values and feelings of concern for the environment and motivation to actively participate in its improvement and protection; and 4) acquire the skills to identify and solve environmental problems. Lastly, it stated the final objective of EE is to provide social groups and individuals with an opportunity to be actively involved at all levels in working toward resolution of environmental problems.

Although the term "environmental literacy" is not explicitly stated in any of these previous documents, they set the groundwork for environmental education that aims to foster an environmentally literate citizenry. Fostering environmental literacy within the American population plays a vital role in creating a citizenry committed to pro-environmental behavior, and active in the formation of public policies (Stevenson et al. 2013, White et al. 2014). Moreover, environmental literacy is crucial for meeting current and emerging environmental challenges across the globe as environmentally literate citizens can assess environmental issues and develop effective solutions (Stevenson et al. 2013). The North American Association for Environmental Education (NAAEE) distinguishes environmental literacy as the ultimate goal of environmental education and identifies the Belgrade Charter and Tbilisi Declaration as guiding documents for its framework of EE (NAAEE 2004). Within my study, my discussion of environmental education focuses on EE that builds environmental literacy.

Environmental Literacy

What is environmental literacy? The term environmental literacy was first introduced by Charles Roth when he posed the question "how shall we know the environmentally literate citizen?" (Roth 1968). Since Roth's famous question, there has been continuous debate over what

it means for someone to be considered environmentally literate and what that entails. In 1992, Roth attempted to further define environmental literacy and described it as " the degree of our capacity to perceive and interpret the relative health of environmental systems and take appropriate action to maintain, restore, or improve the health of those systems". Roth's definition emphasizes that environmental literacy involves action. According to Roth, environmentally literate individuals must be able to demonstrate what they have learned in an observable form, that is through their behaviors.

The emphasis on behaviors and action continues within other definitions of environmental literacy. The NAAEE has defined environmental literacy as an awareness of and concern about the environment and its associated problems, as well as the knowledge, skills and motivations to work toward solutions of current problems and the prevention of new ones (NAAEE 2004). This definition is the most widely accepted meaning of environment literacy (McBride's 2013). And, while other definitions or frameworks may differ in certain aspects, they generally consist of the same elements. Roth (1992) identifies four strands of environmental literacy: Knowledge, Skills, Affect, and Behavior.

In an analysis of the different frameworks of environmental literacy, McBride et al. (2013) reports that they all generally contain four major components: knowledge of basic ecological concepts, environmental sensitivity or appreciation, awareness of environmental issues, and skills and behavior to address these issues. Similarly, the NAAEE framework of environmental literacy also follows these four strands. It describes the aspects of environmental literacy as: 1) conceptual understanding about environmental issues, 2) problem-solving and critical thinking skills, 3) a predisposition toward the environment and natural world, and 4) pro-environmental behavior in personal and civic realms. These frameworks are all consistent with Roth's identification of four strands of environmental literacy, but how are these elements related and what do they entail?

The possession of knowledge is a central component of environmental literacy. Environmental knowledge encompasses knowledge of the physical ecological system, environmental issues, socio-political systems and strategies for addressing environmental issues (NAAEE 2011). As highlighted by McBride et al. (2013), knowledge of basic ecological concepts is a major component of most environmental literacy frameworks. This form of knowledge, as described by Hungerford et al. 1980, includes ecological concepts such as: individuals, species, populations, communities, ecosystems, biogeochemical cycles, energy production and transfer,

interdependence, niche, adaptation, succession, homeostasis, and man as an ecological variable (Hungerford et al. 1980). In the past, a popular view was that increased environmental knowledge would lead to behavioral change, a desired outcome of environmental literacy (Hungerford and Volk 1990). However, most literature has moved past presuming a direct causal relationship between environmental knowledge and pro-environmental behavior (Chawla and Cushing 2007). Still, it is said to be contingent on the possession and comprehension of environmental knowledge (Carter and Simmons 2010).

The second component of environmental literacy is skills, particularly critical thinking and problem-solving skills. Marcinkowski (1991) highlights that environmental literacy requires the skills to analyze, synthesize, and evaluate information about environmental problems as well as evaluate a specific issue based on evidence and personal values. He also emphasizes the need for problem-solving skills within environmental literacy. He states that environmental literacy also requires the skill set to develop, implement and evaluate single strategies and composite plans for remediating environmental problems. Although knowledge and skills increase competency in solving environmental issues, environmental literacy also requires a willingness to take such action (Hungerford and Tomara 1977).

Affect, in relation to environmental literacy, refers to environmental sensitivity, attitudes and values (Simmons 1995, Roth 1992). Environmental sensitivity is defined as an empathetic perspective toward the environment (Hungerford and Volk 1990). Attitudes and values are also empathetic and appreciative toward the environment. Roth describes that there should be a sense of investment in and responsibility for the resolution of problems and issues along with a respect for both nature and society (Roth 1992). Feelings of personal responsibility motivate individuals to work toward solving environmental problems.

The behavioral component of environmental literacy ultimately represents the actions that demonstrate that an individual is environmentally literate. Environmentally responsible behaviors can be divided into two types of behaviors: personal conduct and civic engagement. Examples of personal conduct include actions such as recycling, reducing water and energy consumption, purchasing products in reusable containers or avoiding items with toxic byproducts (Hungerford et al. 1994). On the other hand, civic engagement can include actions such as signing a petition, writing letters to elected officials in response to an environmental issue or participation in a lawsuit aimed at protecting the environment. All these behaviors contribute to environmental problem-

solving, which is a central aspect in essentially all frameworks of environmental literacy (McBride et al. 2013).

Environmental literacy, although it has strong associations with environmental education, is different from EE. Environmental literacy emerges around the same time as EE, in a time of growing environmental awareness and concern, and is often discussed in the lens of environmental education. However, Stables and Bishop (2001) argues that viewing environmental literacy as a subset of environmental education is a weak conception of it. Rather, "strong environmental literacy" is broader than environmental education. While I agree with this argument, environmental education is also a powerful avenue to foster environmental literacy- what does this look like?

EE in K-12 Schools

Knowledge on the current status of environmental education and environmental literacy in the United States is very limited (ELTF 2015). Not much is known about the level of environmental literacy possessed by students or their access to EE. However, several states have created statewide plans for environmental literacy. In the state of Maryland, environmental literacy is a statewide high school graduation requirement. The requirement calls for each local school system to develop an environmental education program that aligns with Maryland's environmental literacy curriculum standards. For California, a report published in 2014 outlined guiding strategies and recommendations for achieving environmental literacy in all California students. It highlighted that students gain environmental literacy "through a broad curriculum that includes expertly delivered classroom and out-of-classroom education by formal and informal educators".

There is no singular way to build environmental literacy through environmental education. One common misconception among teachers is that environmental education pertains mostly to science curriculum (Ham and Sewing 1988). However, EE goes beyond science education and instead develops environmentally literate students (Hungerford 2005). For the purpose of my study, I will be looking at three ways in which environmental education and literacy can appear in schools: individual environmental courses such as AP environmental science, out-of-classroom education, and integration of environmental curriculum.

AP Environmental Science

Most commonly, environmental education is offered as a stand-alone class. One primary example is AP Environmental Science. Environmental science is one of the fastest growing AP courses nationwide (Robelen 2012). The AP Environmental Science course is meant to be comparable to an introductory college course. The course consists of nine units: Ecosystems, Biodiversity, Populations, Earth Systems and Resources, Land and Water Use, Energy Resources and Consumption, Atmospheric Pollution, Aquatic and Terrestrial Pollution and Global Change. Moreover, the course incorporates four "big ideas". The first being "energy transfer": the concept that energy conversions are the basis of all ecological processes. The second is "interactions between earth systems": the concept that the earth is one interconnected system. The third is "interactions between different species and the environment": the concept that humans alter natural systems and have had an impact on the environment for millions of years. Lastly, the final big idea is sustainability: the concept that human survival depends on developing practices that will achieve sustainable systems. These four big ideas are said to be the foundation of the course and enable students to create meaningful connections among concepts and deeper conceptual understanding. The AP Environmental Science course framework also includes "science practices" which it states are distinct skills that students should practice throughout the year (Table 1). The science practices are heavily focused on analytical skills. The premise of building these skills is that they will help students to think and act like environmental scientists. At the end of the course, students can demonstrate the knowledge and skills they have acquired by taking the AP Environmental Science Exam.

Table 1: AP Environmental Science, Science Practices. Skill description was provided by College Board Advanced Placement.

Skill	Description
1. Concept Explanation	Explain environmental concepts, processes and models presented in written form
2. Visual Representations	Analyze visual representations of environmental concepts and processes
3. Text Analysis	Analyze sources of information about environmental issues
4. Scientific Experiments	Analyze research studies that test environmental principles
5. Data Analysis	Analyze and interpret quantitative data represented in tables, charts and graphs
6. Mathematical Routines	Apply quantitative methods to address environmental concepts
7. Environmental Solutions	Propose and justify solutions to environmental problems

Out-of-classroom

Students can also receive environmental education out of the classroom, such as clubs, school gardens, outdoor field trips, or service projects. Field trips such as visiting a degraded area, or the planting of a school garden can help provide students with concrete experiences that help them reflect on and build their environmental attitudes and values (NEEF 2015). In Connecticut, a program called Solar Youth does just this and provides students the opportunity to carry out service projects. Participants of the program are taken out to explore their community, learn about environmental problems in their area. They are then supported in developing solutions to these problems. Some examples of student accomplishments have been raising money for recycling programs, planting gardens, building bridges to increase access to natural areas and educating their own communities (NEEF 2015). The National Environmental Education Foundation describes that programs like these foster environmental literacy by increasing students' knowledge of their communities, motivating them to take personal responsibility for finding solutions, developing their skills to take action and helping them learn to follow through on their plans.

Clubs are another way for students to build their environmental literacy. Schools may have environmental clubs that focus on developing environmental behaviors such as recycling clubs or waste reduction clubs. On the other hand, other forms of environmental clubs may focus on education and increasing awareness of environmental issues. Moreover, school clubs can also provide students opportunities to participate in service projects. Even clubs that are not necessarily environmentally focused may host events such as beach clean-ups.

Integration in curriculum

In California's Blueprint for Environmental Literacy, it is stated that environmental content should be integrated into core curriculum, such as Science, Social studies and English. However, this is not the case for many schools. In 2014, Paul Chapman conducted a study that looked at environmental education and sustainability practices in U.S. public schools. He surveyed public school principals in twelve states and found that only 17% of school principals identified their school as very successful in integrating environmental education in the curriculum (Chapman 2014). For California that number was only 13%. Chapman states that the most successful schools defined environmental literacy, used it to evaluate and revise curriculum and provided professional development for the faculty to integrate environmental education in the academic program.

In California, Environmental Charter Schools (ECS), comprised of three campuses in Inglewood, models how integration of environmental literacy might look in practice. ECS notes that it tries to work on ways for students to access core discipline learning through an environmental perspective, by using an Interdisciplinary Benchmark Assessment (IBM) which is their version of a midterm. One example of an IBM required students to examine gentrification in their community and the impact of building a renewable energy facility. Students were challenged to take into consideration the economic makeup of the residents, income advantages and disadvantages of the city, developments and its associated impacts as well as the cultural impact of gentrification. Students were divided into teams that worked on developing a blueprint of a new sustainable Inglewood community.

Such a substantial and interdisciplinary project allowed for the integration of environmental content into core subject areas. ECS highlights that students used math to calculate the amount of land needed for new residential development and the additional resources that would

be needed to sustain both the current and growing population in Inglewood. In English, students learned how to communicate effectively, and were challenged to develop and produce a written proposal on collaborative, sustainable solutions for urban development. In science, students identified environmental impacts of gentrification and looked at energy outputs. Lastly, in history, students learned about past times when change was needed to support civil and human rights. Overall, the case of ECS allows us to see the potential to integrate environment content into traditional academic curriculum.

METHODS

Teacher Interviews

In order to examine the environmental education offered to students and barriers for its implementation, I conducted semi-structured interviews with science or environmental teachers at two schools, one in an urban setting (Richmond High School) and one in a semi-rural area (Soledad High School). By using semi-structured interviews, I was able to gather similar information from each school while still accounting for their differences.

I interviewed a total of eight teachers, four from Soledad High school and four from Richmond High school Because Richmond High and Soledad High do not have a specific environmental program/track, nearly all the teachers that I interviewed were science teachers. Environmental education is most equated with science education, so this is where I expected to find most of the environmental curriculum. Science teachers I interviewed taught Integrated Science, Biology, Physics, Chemistry and AP Environmental Science. Many of them teach more than one subject. For Richmond High, I also interviewed one elective teacher who teaches Urban Agriculture. Interviews were not meant to be evaluative, rather informative. Teachers were asked questions regarding the implementation of environmental curriculum in their respective courses as well as school-wide environmental education.

Study Sites

Soledad, California

Figure 1. Soledad California. Aerial image was provided by Google Maps.

Soledad is a small, semi-rural town in Monterey County, California. It is located 25 miles south of Salinas CA, which is the most populated city within Monterey County. With an area of only 4.4 miles, Soledad has a population of about 26,000. Nearly 73% of Soledad's population identifies as Hispanic or Latinx. Soledad's median household income is around $64,500, not much below the national average. However, when looking at the per capita income, Soledad's falls well below the national average of $37K and is only about $14,500.

Soledad lies adjacent to the U.S. Route 101, and offers an entrance point into Pinnacles National Park. It is also located in the Salinas Valley, which is often referred to as the salad bowl of the world. Agriculture is one of the industries in this area. The largest job group in Soledad is Farming, Fishing and Forestry Occupations likely because there is a high number of agricultural field workers. About 20% of Soledad residents fall in this job group. While this is the most

common occupation group, it is not the highest paid group. Law enforcement workers, protective service occupations are the two highest paid jobs in the town.

Soledad High School is the only public high school that serves the predominantly low-income, Latinx community of Soledad. Soledad High is a Title 1 school. The student demographics of Soledad High students reflects that of the community. In the 2018-2019 school year specifically, nearly 94% of students at Soledad High were Latinx and over 90% were identified as socioeconomically disadvantaged. (Table 2). For a student to be considered socioeconomically disadvantaged, the student must meet one of the four criteria laid out by the California Department of Education. Participation in the Free or Reduced meal program is one of these criteria.

Table 2. Student demographics 2018-2019 school year at Soledad High. Data provided by Soledad High School's School Accountability Report Card 2018-19.

Student Group	Soledad High
Black or African American	0.5%
American Indian or Alaska Native	0.1%
Asian	1%
Filipino	1.3%
Hispanic or Latino	93.8%
Native Hawaiian or Pacific Islander	0.2%
White	2.7%
Two or More Races	0.4%
Socioeconomically Disadvantaged	90.5%
English Learners	11.8%
Students with disabilities	11.7%
Foster Youth	0.2%
Homeless	2.1%
Total Number of Students	1,492

Richmond, California

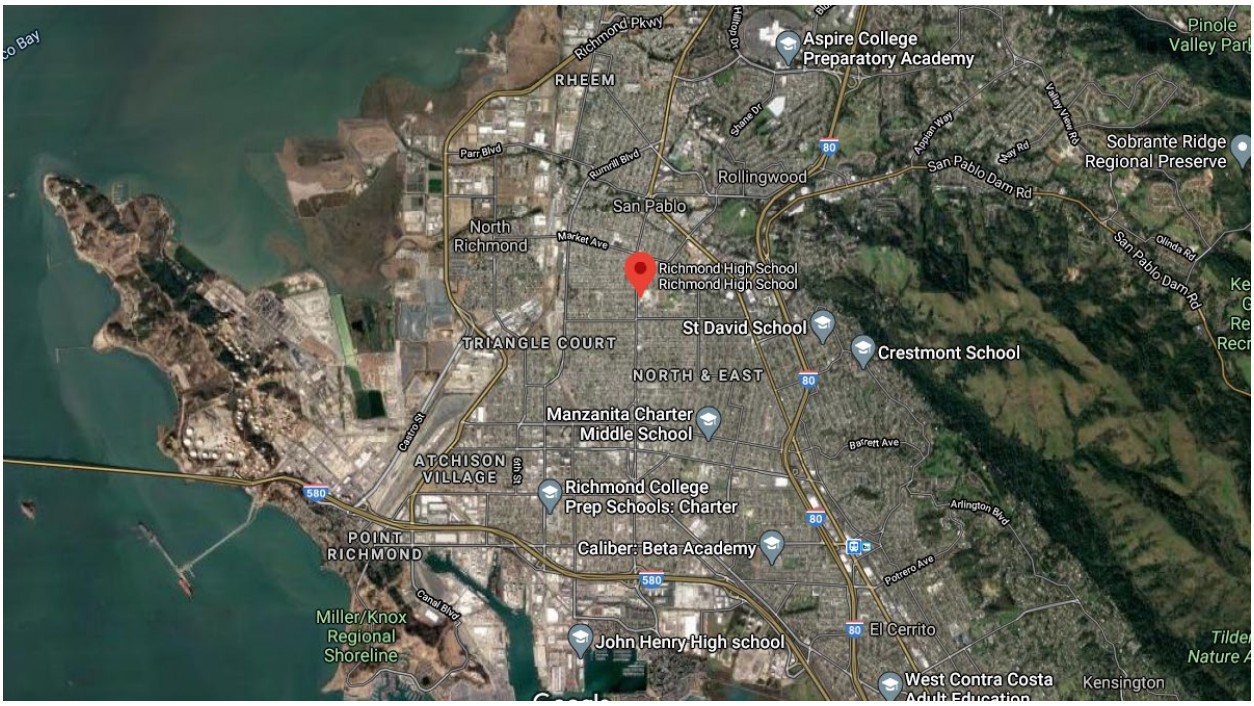

Figure 2. Richmond California. Aerial Image provided by Google Maps.

Located in the Bay Area, Richmond is a large suburban community within Contra Costa county. Richmond is about 25 minutes northwest of San Francisco. With over 100,000 residents, Richmond's population is slightly more diverse than Soledad's. Still, most Richmond's residents are also primarily People of color (POC). Specifically, 42% of residents identify as Latinx and 20% identify as Black. At around $68,500, the median household income of Richmond is only about $4,000 more than Soledad, yet its per capita income is more than double than Soledad. Nonetheless, Richmond's per capita income also falls below the national average by $6K.

The city of Richmond has an area of 52 miles and borders the San Pablo and El Cerrito communities. In 1902, the Chevron Richmond Refinery was established in Richmond. The Chevron Refinery has historically plagued the city with environmental disasters such as chemical leaks, oil spills and even fires. However, despite these hazards, the petroleum refinery is the city's largest employer. Over 1,000 people work at the Chevron Refinery.

Richmond High School is located just four miles away from the refinery. Richmond High is one of six high schools within the West Contra Costa Unified School District. Although it is situated in the city of Richmond, Richmond High School serves students from not only Richmond,

but also from the surrounding community of San Pablo. Despite serving two Bay Area communities, the total number of students enrolled at Richmond High in the 2019-2019 school year was like Soledad High with around 1,500 students. In the same school year, the student population of Richmond High was 85% Latinx and 7% Black (Table 3). Over 93% of students were identified as socioeconomically disadvantaged.

Table 3. Student demographics 2018-2019 school year at Richmond High. Data provided by Richmond High School's School Accountability Report Card 2018-19.

Student Group	Richmond High
Black or African American	6.9%
American Indian or Alaska Native	0.1%
Asian	4.4%
Filipino	1.8%
Hispanic or Latino	85.1%
Native Hawaiian or Pacific Islander	0.4%
White	1%
Two or More Races	0.3%
Socioeconomically Disadvantaged	93.5%
English Learners	39.6%
Students with disabilities	10.3%
Foster Youth	0.2%
Homeless	4.9%
Total Number of Students	1,5967

RESULTS

Environmental Curriculum

Although neither Richmond High nor Soledad High have any built-in environmental courses within their main track academic program, both schools offer AP Environmental Science. Throughout my research, I found that the majority of environmental curriculum at these schools is largely taught at teacher discretion. Like most public schools, Richmond and Soledad do not fully/explicitly integrate environmental curriculum within their science courses. However, these schools have, to some degree, implemented what is called, Next Generation Science Standards

(NGSS)[1]. These standards are said to aid the integration of more environmental topics within traditional science courses.

Soledad High School

While some teachers have implemented NGSS standards within their courses, it is unclear whether NGSS standards are fully implemented throughout the science department. Most of the environmental education instead appears to occur in the form of environmentally related modules in courses. When asked if they taught any environmental curriculum, teachers who responded "yes" typically referenced a module within their courses. An example of this is in the integrated science course which is offered within the "main track" science courses (courses that fulfill requirements for graduation). Integrated science is typically a course taken by entering freshman.

One integrated science teacher described that the course is very similar to a biology course but is designed to line up with a state science assessment that is administered in the 10th grade. The teacher highlighted that they attempt to incorporate the topic of climate change within the ecology module. Alternatively, a second teacher teaches both integrated science and biology describes using research projects within the ecology module to have students research endangered species and how their population can be brought back to healthy rates as well as how to help. For the biology module within integrated science, a similar project is assigned relating to environmental groups that focus on conservation.

Soledad High's AP Environmental Science course, interestingly, is offered through their Agriculture department rather than their science department. One of the reasons why the Agriculture department can offer AP Environmental Science is because teaching the course does not require a science credential. Instead, to teach the course, a teacher just needs a certificate that states they attended an AP seminar. The AP Environmental Science course began to be offered about three years ago due to student demand. It replaced an honors science course that was previously offered by the department. Though, the demand was not so much for an environmental science course rather the designation of AP. In fact, apparently at times students enroll in the course for the sole fact it is an AP course, and do not really understand what the course is about. Still, the

[1] NGSS standards are voluntarily adopted state K-12 science content standards.

APES teacher described that although students may not always know what they are getting into when enrolling into the course, they generally become interested in the material.

Soledad High's Agriculture department is a unique feature of Soledad High, as not all high schools have an agriculture department. The department offers its own alternative biology and chemistry courses. Classes offered through the Ag department are typically taken by students who are part of Soledad's ag program, but the courses are open for any student to take. Ag Biology and Sustainable Agriculture are two alternative biology courses that students can take opposed to "main track" biology offered by the science department. For Chemistry, the alternative is Ag Chemistry, which as opposed to general chemistry, focuses on soil science such as soil sustainability and its impacts on the environment, like erosion weathering and chemical weathering. The course also touches on solar energy and production, soil structure composition, soil formation, water and soil relationships, and sustainability.

These biology and chemistry courses were designed by a committee formed by the Ag department with the goal of integrating student's biology and chemistry credits with more real-world applications. The course curriculum is adopted by the state under the UCCI curriculum, a curriculum that integrates A-G academic requirements with Career Technical Education (CTE) in order to help students, prepare for college while also exploring career paths. The courses relate traditional required science content to agriculture and can only be taught through an Ag department by a teacher with an Ag credential. Instead of being elective based, students who take the classes are also able to get graduation credits. The courses are also in line with NGSS standards.

Richmond High School

Similar to Soledad High School, this study found that Richmond High is also in the process of implementing NGSS standards in its science courses, however it is unclear to what extent they have been implemented. In Biology, the transition to NGSS standards began about five years ago. However, at the beginning of the transition, there was no previous in Physics, one of the current Physics teachers stated that there is no environmental science component in the courses. In chemistry, one of the teachers commented that the new standards enable teachers to intertwine the environment within every aspect of chemistry. Moreover, the teacher also related that they,

personally, are increasingly able to work in an environmental perspective within their chemistry curriculum due to a few reasons.

First, Richmond High is said to be pushing for more project/problem-based learning, where teachers can choose their own projects. Secondly, due to this teacher's background in teaching AP Environmental Science, it makes it easier for them to choose a curriculum that relates to both the environment and chemistry concepts. Third, the Chemistry department is in the process of adopting a new textbook that aligns with NGSS standards and integrates earth science into chemistry.

While Richmond High also does not have a main track environmental course, the school does offer an elective course called "Urban Agriculture". The course is heavily focused on environmental justice. As opposed to approaching environmental literacy from a hard science perspective which focuses on the science behind environmental issues, the course approaches it from a social justice, or environmental justice, perspective focusing on community and local environmental issues. As an elective course, the curriculum is established by the teacher themself, giving them a lot of flexibility. The course goes through planet earth and the four seasons as experienced in the Bay Area as well as the difference between climate and weather. It also covers global warming and climate change, particularly the impacts of such on Richmond as it pertains to environmental justice. The teacher of the course highlighted that it's similar to connecting the dots and making sure students can understand certain concepts such as how changes in the weather result from refinery emissions, how it can be tracked, and how melting glaciers and Tibet relate to experiences in Richmond due to the refinery.

The course first originated as an afterschool program around 2007. The program gained a lot of attention and popularity among students, leading to school administration creating a pilot class that has since continued to be offered. For about four years, starting in 2010, the US Department of Agriculture's Community Food projects helped fund the program. It paid for the course teacher, project materials and construction of a school garden. The teacher of the course emphasized that Richmond is an inner city with little access to green spaces. One main goal of the program is to reconnect students with the land and give them a tangible way to learn from while also producing food.

Challenges for integration of environmental curriculum

Soledad High School

Issues with state standards: Emphasis on state-tested content. Although NGSS standards are supposed to better integrate the environment into science courses, the AP Environmental Science teacher who also has experience teaching multiple other AG courses still commented that trying to fit the mold of these standards still makes it difficult to incorporate environmental science into the ag science courses. One of the integrated science/biology teachers also highlighted a similar issue in both their classes. They explained:

> *"Our environmental education...as a main track teacher, we're at the mercy of whatever standard system [the state] have set up at the time."*

In their biology course, they stated that the focus for biology is DNA, heredity and evolution, specifically because those are the topics that students will be tested on by the state. Because of this, any environmental content unfortunately gets pushed to the side with the justification that other topics are the focus of the standards.

For integrated science, they commented that opportunities to "really get into climate change" in just basic ecology is pushed to the side because of standardized instruction. Moreover, the focus on standardized testing and instruction restricts teachers with certain expertise or passions, such as environmental education, from incorporating these passions in their courses. However, one of the positives of standardized instruction is that teachers can collaborate since they are all teaching the same material.

On the other hand, another biology teacher who described using the ecology module to teach about climate change, stated that they try to teach the course in a way that allows them to have extra time at the end of the course to do so. They stated that they can do so because it is not tested for by the state. Moreover, they stated that teaching students about climate change enriches their understanding of ecology, and it also vital to bringing about awareness within their students.

Lack of funding. Funding was another major issue highlighted by multiple teachers, with a teacher even expressing that "money is always an issue". Low classrooms budgets restrict the activities that teachers can carry out with their students, in and out of the classroom. One teacher described that in the past there was a teacher who was pushing to try and take students on field trips. According to this teacher, while group capacity limits for certain field trip locations can be a struggle, the costs and gaining administrative support for field trips posed the greatest difficulties in doing so.

Another teacher highlighted that if you are "doing the things you need to do [meeting test standards] then you're going to get your full funding". Though, they also noted that even then funding is low, which also impacts the equipment that students can access. Lack of funding for equipment also feeds into difficulties with student learning. The same teacher brought out that it's one thing to teach students theory and subject but another to be able to have them apply it, which is hard to do with such tight budgets that limit access to equipment.

Student difficulties. In AP Environmental Science, one difficulty for students is the high math content within the course. With "very low" math scores, a lot of students struggle with math. The APES teacher commented that taking baby steps, while it takes more time, helps students grasp the content and then they can contextualize the math problem and increase their understanding. Additionally, when the course lessons can be related back to the students and the area they live, they are more likely to grasp concepts versus viewing them as a foreign theory.

Similarly, another teacher brought out the difficulties students face engaging with and understanding concepts that involve things they have never seen or experienced first-hand. The teacher explained:

> *"Sometimes [students] talk about wolves, and although they're interested in wolves, sometimes they can't grasp, that like,' I could save the wolves', 'but we don't even have wolves, so what's the point?' so they really do need to find something that they could connect to, in order to really be engaged in a lesson."*

Moreover, this same teacher also highlighted that students can follow a lesson as long as they understand the language. However, once students get lost in the language being used, its hard to re-engage them.

Soledad High students were also described as needing more time to understand a lesson compared to students who attend other high schools, which one teacher suggested it may be due to students preparation since elementary school and level of understanding (i.e., low test scores). Because of this the science department ultimately decides to prioritize a few main standards versus all of the standards so students are able to effectively understand the content.

Location. The location of Soledad High was described as an obstacle to being able to teach environmental content hands-on and provide students with first-hand learning experiences. Because of Soledad's semi-rural location, there is limited access to certain educational resources. One integrated/biology teacher described the contrast in access to resources at more urban schools:

> *"we don't have the best resources; we don't even have resources that are available to us. I've talked to some of my friends from San Diego. And they're like, Oh, yeah, we had our hospital down the street. We had a botanical garden, like around the corner. This museum told us about this, and this and this. And, we just don't have that."*

Lack of funding further exacerbates the issue of providing students with firsthand learning experiences as there is little funding to take students on field trips.

On the school campus itself, the APES teacher commented that facilities and space are an issue for the agriculture department. While there is a greenhouse on campus, it is not fully functioning as the facility is missing panels, which the school district will not fix. Additionally, there is no access to areas where they can take students to do activities such as soil testing, water testing, or hydroponics.

Neutrality. A surprising topic brought up by two teachers was the concept of neutrality and issue of parental complaints. One of the teachers highlighted:

> *"the environment is a hotbed topic. When you bring up the term climate change, even though it's science, it just has different pressures in the way that you discuss it and bring it up."*

With experience teaching in different regions of California, the teacher explained that depending on where you are teaching, it is likely you will receive a complaint from a parent because a lot of people view climate change as an opinion. They further shared:

> *"being able to express the truth is the most frustrating thing as a science teacher because you're taught it's all about the data and that data doesn't have a bias".*

While they have never personally had a parent complain, the potential of parent complaints results in having to be "diplomatic" in what they say, which gets in the way of trying to spark passion and interest in these issues. Still, the teacher also highlighted that, on the opposite spectrum, you may get a little bit more leeway to discuss certain topics based on where you are located, such as in the Bay Area. Expanding on this issue, a second teacher commented that another challenge is that they do not know if certain topics are "restricted" until after they have discussed it and have received a complaint.

Richmond High School

Issues with state standards: Transition to NGSS. For one teacher who entered their first year of teaching during the transition to NGSS standards, they described that the novelty of NGSS meant the first year of the transition there was no Biology curriculum that existed which meant they had to design their own curriculum. While the implementation of NGSS standards may be easier for teachers with a background in environmental science, it can be challenging for those who do not have such experience. The teacher explained that growing up in the Midwest they had little exposure to environmental science throughout their education despite getting a degree in Biology. This translated into increased difficulty when trying to develop project ideas or come up with phenomena to show students.

Additionally, they explained other teachers also faced difficulty with the transition to NGSS standards as some teachers felt the standards were hard to understand. For teachers who were used to teaching science in a certain way, the new standards were a different way of teaching science. As a result, some teachers did not really transition to the new standards. Moreover, teacher turnover rates also made it difficult to transition to the new standards as many teachers would end up "doing their own thing" due to the lack of a set biology curriculum and assessments.

Issues with state standards: Emphasis of state-tested subjects and content. One teacher commented that environmental content is in the district scope and sequence, a document that teachers receive. However, they explained:

> *The reality in every school I've taught, many schools I've heard of, is that nobody's actually checking on that scope and sequence. Most of the teachers I know are doing it really well. But the environmental science lessons are toward the end, it's the last suggested unit. And oftentimes, they don't get the full time they deserve. They're cut short because the school year ends, because someone hasn't planned properly or is falling behind in their schedule.*

One teacher expressed that there's so much pressure to focus on math and English that science seems to get forgotten. They described that during the past WASC accreditation audit there was no review of any of their teaching material to make sure standards were being met.

Funding. Funding is another recurring issue. This is particularly an issue for field trips. Support from administration for field trips and other activities is generally contingent on teachers finding a way to fund the activities. One teacher explained the issue with this as:

> *It's also a way of saying no, though, and I'm sure you recognize it. At a lot of schools, right, like schools that aren't so financially pressed. ... There are field trips that the kids can go on that we can't afford.*

This same teacher commented that if there was more money available, location would not be an issue. Students would be able to go on field trips that would allow them to gain more first-hand

learning experiences with nature and build a greater connection to the natural environment. Available funds tend to be prioritized for teachers and courses that need the most help. However, for the Urban Agriculture, funding is not as significant of a challenge since the course is a partnership with the organization Urban Tilth. This enables the course teacher to access resources and funds for the program.

Student difficulties. As for in the classroom, many teachers also highlighted that many students face a language barrier, which makes it harder for them to understand new concepts. Richmond High has a substantial number of students that are English learners who have recently immigrated to the U.S. The Urban Agriculture teacher highlighted:

> *[There are] a lot of English learners, a lot of folks that are recent immigrants from other countries. My classes become popular because I'm somewhat bilingual and I can kind of like, you know, if a student needs help on the side, in Spanish, I can break it down. Whereas there's not a lot of teachers that Richmond high unfortunately, who are able to do that.*

Although these students may be receptive to course material, they need more simplified, broken down explanations of certain concepts. One teacher highlighted that students struggle with reading articles assigned in their chemistry lessons. Even when reading the articles together, students are said to still have a hard time following the material and fully comprehending it.

Location: Access to green space. The school garden was mentioned by every teacher that was interviewed as green space on campus. However, lack of access to green spaces was still a prominent challenge highlighted by teachers. At the beginning of my interview with the Urban Agriculture teacher, they immediately described Richmond as an inner city with little access to green space. Physics teacher with experience in previously teaching Biology expressed that relative to their own passions and background, they probably deemphasized environmental components in their courses. This teacher recognized that they could have likely worked in more environmental aspects into their courses in the past. However, they explained:

> *I really want [lessons] to be direct, tangible experience. And because we were stuck in the middle of Richmond on 23rd Street, where there is precious little of any kind of, quote, natural environment, there was not a lot of environmental science.*

They also mentioned that an alternative may be to show a video in class, but that they believe it is hard for students to create a personal connection to the environment in this manner. Moreover, there is no "touchstone" experience for them to talk to all their students about, and lack of access to green spaces makes it difficult to create one.

DISCUSSION

Throughout my research, I found that students in both Soledad High school and Richmond High school have limited access to environmental curriculum. Despite location differences in one school being in an urban setting and the other in a semi-rural area, implementation barriers for environmental curriculum are very similar at Richmond High and Soledad High. Emphasis on state-test content, lack of funding, and student difficulties with learning were the three most important barriers at these schools. Prioritization of meeting state standards, within courses and on a school-wide level, is likely the largest, overarching factor limiting environmental education at these schools.

Access to environmental curriculum

At Richmond and Soledad High, implementation of environmental curriculum has been largely left up to teachers. While both schools have made strides toward increasing their available environmental curriculum by offering AP Environmental Science and moving to implement NGSS standards, there has been a lack of oversight to ensure these standards have been implemented throughout all their science courses and in a manner that supports environmental education. However, the availability of AP Environmental Science at these schools should be recognized as Black, Latino, and low-income students typically have less access to AP courses (Zarate and Pachon 2006). The existence of Soledad's Agriculture department and Richmond's Urban Agriculture course are also auxiliary environmental education opportunities that not all high

schools offer. Still, the lack of access to integrated, structured environmental curriculum is likely limiting students' ability to develop strong environmental literacy.

Teacher Challenges

Emphasis on state-test content, lack of funding, and student difficulties with learning were three of the most prominent recurring challenges discussed by teachers at both schools. In another study that looked at barriers to environmental education, Ham and Sewing (1988) found that lack of time was the primary barrier that were inhibiting teachers from implementing environmental education in the classroom. Lack of funding and resources were two other important barriers. While Ham and Sewing's study did not consider school demographics, these barriers were also significant in this study. In relation to the emphasis on state-tested content, time is an important factor in this challenge as priority of state-tested content leaves little time for incorporation of environmental content.

Student difficulties, however, seems to be a stronger challenge due to student demographics of Richmond and Soledad High. In their master's theses, Mayeno (2000) investigated the environmental education needs and preferences of inner-city communities of color and sought to build on the barriers identified by Ham and Sewing (1988). While Mayeno's study focused on outside environmental education programs, they also found that the most significant barrier was funding. Moreover, the study also found that lack of Spanish language materials and/or Spanish speaking educators was a common barrier as 46% of students had limited English proficiency. Similarly, teachers in Richmond highlighted the large presence of English learners at the school. While one teacher did also comment on the lack of Spanish speaking teachers at Richmond High, none mentioned lack of Spanish language materials as a challenge. Still, the discussion of language barriers in my research and Mayeno (2000) highlights the additional barriers that communities of color may face in receiving an environmental education.

Additionally, challenges regarding neutrality and access to green space are likely due to the rural and urban location of each school. The Bay Area tends to hold more progressive ideologies, which may be why the topic of neutrality did not come up in Richmond but did in Soledad High. Conservative views are more strongly associated with the belief that climate change is a hoax, or not that serious, and is something Richmond teachers may not have to deal with as

much. Instead, lack of green space was a significant challenge within Richmond High. Lack of access to green space in urban areas is a well-known disparity.

Influences of school-wide environmental education

On a school-wide level, meeting state standards in Math and English performance seems to be the main priority of both schools, which inhibits the expansion of EE at these schools. State priorities and standards have a huge influence over school funding and accreditation. In 2001, the passage of the No Child Left Behind (NCLB) Act linked federal funding for public schools to their performance on standardized tests. Although this legislation has now been replaced, Gruenewald (2007) emphasizes how this legislation created a 'high-stakes' environment which pushed out environmental education. This research provides an example of this high-stake environment as both Richmond High and Soledad High face significant pressure to pass the Western Association of Schools and Colleges (WASC) audit for accreditation, which is meant to ensure that public schools are completing certain requirements in Math and English.

Although California's department of education has started to recognize the importance of increasing environmental education and more importantly environmental literacy, the progression of these initiatives appears to be slow. NCLB was replaced, but the focus remains to be student math and English performance. This leaves Richmond and Soledad High who are underperforming under a lot of pressure, and unable to prioritize or give attention to expanding environmental education at their schools.

LIMITATIONS

One of the major limitations of my study was the lack of student inclusion. Inferences of student environmental literacy are made based on lack of environmental curriculum and implementation of NGSS standards. However, without actual evaluation of student environmental literacy, this is not definitive. Moreover, it is possible that students are also receiving environmental education in other subject courses, but since most teachers I interviewed were science teachers, there was no way of knowing this.

This study also did not examine of all the avenues of environmental education that may be occurring at these schools. A more comprehensive study that involves students, teacher and administration would provide a clearer picture of the state of environmental education at Richmond High and Soledad High.

BROADER IMPLICATIONS AND FUTURE DIRECTIONS

Expansion of environmental education in POC and low-income communities must be prioritized. Although this research did not comprehensively examine EE at Richmond High and Soledad High, my findings still highlight the inequity of access to quality environmental education and lack of priority for its expansion at these schools. It is likely that this the case for many other low socioeconomic high schools. Public high schools unfortunately do hot have control over state standards and priorities. However, although they must meet state requirements, this does not mean they need to place environmental education on the back burner.

According to Hoody (1998), environment-based education has been shown to improve academic performance and learning, regardless of socioeconomic and cultural factors. Integration of environmental curriculum throughout academic programs in high schools with socioeconomically disadvantaged students may help schools improve their student performance. However, Gruenwald (2007) argues that this promotes the use of environmental education as vehicle to close the achievement gap rather than a pathway for environmental literacy and a more sustainable society. Nonetheless, increasing environmental education can aid student learning and performance.

In this research, teachers emphasized the importance of relating course material to student's lived experiences and community. Doing so increased student engagement and understanding of material. Further research should be done on creating environmental curriculum and programs that both help student performance and build environmental literacy. Moreover, environmental education should not only be viewed within the lens of increasing student performance.

Expansion of environmental education is important because it can help empower students. POC and low-income communities are disproportionately impacted by environmental hazards (Cushing et al. 2015, Commission for Racial Justice 1987). At Richmond High School, their

proximity to the Chevron refinery provides an example of this. By expanding environmental education opportunities for POC and low-income students, these students can build environmental literacy to help them address environmental issues in their community. However, this education needs to be rooted in students lived experiences.

While funding is a major limiting factor in accomplishing this, as was the case with Richmond's urban agriculture course, it first began as a program which was funded by a partnership with Urban Tilth, and then led to the piloting of a formal course. I recommend schools with similar issues as Richmond High and Soledad High seek out and establish partnerships with environmental organizations as this can be one way that these schools can begin to initiate and fund environmental programs within their schools as well as bring in the expertise of these organizations.

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