

Negotiating Open Access:  
AP Science Identities in a Project-Based Learning Context

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**Abstract**

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This dissertation studies students' identity negotiation in a project-based Advanced Placement (AP) Environmental Science class. The College Board has encouraged schools to diversify enrollment in AP STEM (Science, Technology, Engineering, and Math) courses, in which White and Asian males have been historically overrepresented. This trend may be connected to the ways in which underrepresented students socially identify with this learning context. Project Based Learning (PBL) has the potential to support students' connection with AP STEM coursework by tasking them with solving real-world problems by using discipline-specific skills and practices. This mixed-methods study uses situative theories of identity to analyze the opportunities and constraints to students' identities in the context of a PBL AP Environmental Science course offered in an urban, poverty-impacted school district. Findings from this study highlight the different ways that AP and Science identities can manifest, and

suggest a relationship between perceived agency in the class and certain students' future plans to pursue science majors in college. In studying the identity processes involved in this evolving context, I hope to shed light on ways that increasingly diverse groups of students might socially identify with the domains of AP and Science.

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## **Dedication**

To possibilities of positive change

## **Chapter 1: Social Identification with AP Science**

This study explores the ways in which students develop identities related to the College Board Advanced Placement Program and Science.<sup>1</sup> Both the Advanced Placement Program (AP) and the domain of Science have educational legacies of social stratification such that those with more privilege in society, more generally, also have more privilege in these domains. In seeking to understand the ways in which students socially identify with Science and the AP program in which science is both taught and learned, I aim to uncover mechanisms that contribute to these identifications and, hopefully, ways to support students who have been historically marginalized in building connections with both Advanced Placement and Science.

In this chapter, I begin by situating this study in a time of innovative curriculum approaches to advanced learning, which aim to support an increasingly diverse student body. I provide the rationale for this particular study that explores the implications of project-based learning for AP and Science identity development.

### **The Current State of AP**

The Advanced Placement (AP) program was created by the College Board to offer college-level curricula in high schools. Some U.S. colleges and universities award course credits to students who pass their AP exams. This program, believed by many to be the most rigorous course of study in United States and Canadian high schools (Sadler, 2010), has historically been a social space of inequity. Since its mid-20<sup>th</sup> century introduction as a course of study for the most ‘superior’ students in United States’ schools (Rothschild, 1999), the AP program has been largely populated by the upper- and upper-middle class tiers of our student population (Lacy,

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<sup>1</sup> “Science” is capitalized when I refer to it as a domain of activity that students socially identify with.

<sup>2</sup> By, “traditional,” I refer to the demographic of students who have historically been most prevalent in AP courses – White, middle to upper-middle class students (College Board, 2014a).

<sup>3</sup> Interestingly, there is a dearth of literature on the history of the AP program. Thus, I draw

2010). Over the past few decades, a compelling case has been made for the value of providing equity of access to high quality curriculum for *all* students (Darling-Hammond, 2004; Oakes, & Lipton, 1992; Slavin, 1996), and there has been a concerted effort to do so. Specifically, there has been an effort to improve equity of access to AP courses.

Some school district-based strategies for increasing diversity in AP have included lowering enrollment prerequisites for AP courses; offering summer courses on how to be successful in AP courses; and creative curricular interventions (Parker, Mosborg, Bransford, Vye, Wilkerson, & Abbott, 2011; College Board, 2015; Lacey, 2010; Klopfenstein & Thomas, 2010). Following these efforts to expand and diversify the AP student body, not only have at least twenty five percent of graduating high school seniors taken at least one Advanced Placement (AP) test since 2012, but “over the past decade, the number of students who graduate from high school having taken rigorous AP courses has nearly doubled, and the number of low-income students taking AP has more than quadrupled” (College Board, 2014b). However, despite efforts to broaden AP access for underrepresented students, the outcomes of these efforts have been mixed. Students who have been historically underrepresented in the AP program, but are a growing proportion of the program’s demographic, seem more likely to struggle with success in AP classes. A recent analyses of the AP program found that most of the test takers continue to be White; the percentage of Black students failing their exams is increasing; and while over half of AP participants are female, they only make up a small fraction of participants in AP physics and chemistry. (AP 10<sup>th</sup> Annual Report to the Nation, 2014a; Aud, Fox, & KewelRamani, 2010; College Board “AP Participation and Performance Data 2015”). The AP program, renowned for its academic rigor, continues to replicate patterns of inequity, despite putting forth goals to resolve these issues. These data indicate that efforts toward more equitable

access to AP coursework is not matched by equitable student outcomes (Warne, Larson, Anderson, & Odasso, 2015; Parker et al., 2013).

One explanation for mixed outcomes (e.g. who is enrolling in and passing which AP classes, and who is taking and passing which AP exams) is the pedagogy associated with AP. In 2002, the National Research Council reported that, despite touting an emphasis on deep learning, this intention for AP classes remained unrealized, especially in the sciences. Contributing to this problem were issues that include insufficient conceptual teaching, failure to recognize differences among learners, and lack of collaboration in the classroom (NRC, 2002). One fairly recent approach to designing AP curricula that fosters deep meaningful learning for a diverse student body is project-based learning (PBL). This is a popular teaching and learning model that promotes student-centered, inquiry-based learning, situated in contexts that address real-world problems (Darling-Hammond & GLEF, 2008; Blumenfeld, Soloway, Marx, Krajcik, & Palincsar, 1991). This model, however, is only recently becoming associated with rigorous content instruction, such as AP courses (Parker, Lo, Yeo, Valencia, Nguyen, Abbott, Nolen, Bransford, & Vye, 2013).

Another explanation for these mixed outcomes (e.g. who is enrolling in and passing which AP classes, and who is taking and passing which AP exams) may be connected to the work of students negotiating the ways in which they socially identify with the changing AP program. Contemporary identity theorists suggest that student outcomes in classes are not exclusively determined by choices students make freely, but are also influenced by the social, cultural, and historical contexts in which learning and identity development occur (Boaler & Greeno, 2000; Holland, Lachiotte, Skinner, & Cain, 2003; Holland & Lave, 2009; Holland & Leander, 2004). For students to develop academic identities, recognizing their learning as

relevant and meaningful, they must perceive such identification as a realistic possibility. These identities “are deeply and profoundly influenced by the multiple settings that students negotiate daily” (Nasir, 2011). As such, they are precipitously susceptible to following the trajectories prescribed by cultural legacies of power and privilege. Under certain circumstances, these patterns can be disrupted and students who have been historically marginalized from AP educational opportunities may find themselves with the opportunity to forge connections with the AP program. Processes of social identification (Holland et al., 2003; Wortham, 2004b) can offer students the chance to position themselves and each other in relation to publicly recognized practices associated with being AP students. Students who are continually positioned to positively identify with the AP program will likely continue on a corresponding identity trajectory as their AP identities thicken over time (Holland & Lave, 2001). On the other hand, this is not as likely to if there is a conflict between students’ identities and the AP learning context. Learning and identity development work together and, ideally, will serve each other (Wenger, 1998).

### **Identity and AP STEM**

In the AP system, a focal area for diversification is in AP STEM (Science, Technology, Engineering, and Mathematics) courses. There has been an explosion in STEM jobs in the past decade and these jobs are expected to grow at almost twice the rate of non-STEM jobs (AP Central, 2013, “AP STEM access program”). According to the College Board, there are not enough students graduating with STEM majors to meet this demand (Advances in AP, 2015, “STEM”). The College Board reports that, among students who demonstrate comparable levels of readiness for AP STEM courses, participation rates vary significantly by race and gender (AP Central, 2013, “AP STEM access program”). In other words, female and non-Asian minority

students are least likely to enroll in AP STEM courses. The College Board relates this to later pursuit of STEM degrees, reporting, “Research shows that students who take AP math and science are more likely than non-AP students to earn degrees in physical science, engineering and life science disciplines” (AP Central, 2013, “AP STEM access program”). In college, “African-American, American Indian/Alaska Native, Hispanic/Latino and female students in the U.S. are less likely to study math and science in college or pursue related careers than their counterparts. As an example, although females were awarded 57 percent of the 1.7 million bachelor degrees in 2009-2010, they only received 17 percent of engineering degrees, 18 percent of computer science degrees, and 41 percent of science degrees, according to the National Center for Education Statistics” (AP Central, 2013, “AP STEM Access Program”). Thus, trends in high school have continued to college majors and STEM-related careers. To increase diversity in this area, the AP program launched the AP STEM Access program in 2013. This program provided monetary incentives for participating teachers who diversify their AP STEM test takers by an increase in five underrepresented minority or female students each year (AP Central, 2013, “AP STEM Access Program”). While this initiative focused on equity of access, it did not include attention to the differential outcomes of these students.

To date, little research has investigated identity work in the diversifying AP STEM context. Substantial research exists on student identities in general education school environments, (e.g. Brickhouse & Potter, 2001; Nasir, 2011; Nasir, McLaughlin, & Jones, 2009; Wortham, 2004a; Wortham, 2004b) and in extracurricular learning environments (e.g. Barton & Tan, 2010; Nasir & Cooks, 2009; Barton 1998). Corresponding with the interest in diversifying STEM are an increasing number of studies on the development of “science” or “mathematics” identities in students who are traditionally underrepresented in these areas (e.g. Brickhouse &

Potter, 2001; Carlone & Johnson, 2007; Barton, Kang, Tan, O'Neill, Bautista-Guerra & Brecklin, 2012; Jackson, 2009; Nasir & Hand, 2008, Tan & Barton, 2008), but not in the AP context. One exception to note is Boaler & Greeno's (2000) study of mathematics identity in an AP context, but the participants were a fairly homogenous group of high-achieving affluent traditional<sup>2</sup> AP students.

### **Study aims**

The influence of PBL on students' learning, achievement, motivation and engagement has also been well documented (e.g. Blumenfeld et al., 1991; Smith, Sheppard, Johnson, & Johnson 2005; Darling-Hammond & GLEF, 2008; Jonassen & Land, 2012; Kanter & Konstantopoulos, 2010). PBL also has potential as a useful curricular context for studying the development of student identities, which, as mentioned, is one curricular reform currently implemented in AP STEM contexts. In this approach to instruction, students take collaborative ownership over "authentic contextualized problems that are meaningful and complex" (Marx, Blumenfeld, Krajcik, Blunk, Crawford, Kelly, & Meyer, 1994, p. 517). In this learning context, students may recognize learning as relevant to their own lives, supporting related identity development. (Barton & Tan, 2009). Findings from one related study conducted by Tierney, G., Goodell, Nolen, Lee, Whitfield, & Abbott (under review) suggested that adjustments to curriculum projects, such as their instructional sequence, that were directed at this connection strengthened the students' identification with environmental science. However, there continues to be little literature attending to the role of project-based learning in the identity development of high school students.

Especially important to designing a PBL curriculum for the AP platform is the balance

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<sup>2</sup> By, "traditional," I refer to the demographic of students who have historically been most prevalent in AP courses – White, middle to upper-middle class students (College Board, 2014a).

between breadth of content coverage and depth of learning (Parker et al., 2013). Students are expected to learn and master the material required for passing the AP exam. A PBL approach goes beyond memorizing facts and procedures, offering students a learning context that supports disciplinary engagement (Engle & Conant, 2002). This kind of engagement means that students are not only engaged, but using discipline-specific skills and discourse in their engagement. In an AP class, disciplinary engagement would be indicative of deep learning of the course content and scholarly skills. According to Engle & Conant (2002), in this environment, students have the authority and resources to address real-world problems, and hold each other accountable for doing this using the skills and practices of the discipline. A PBL AP context can offer fertile ground for studying students' identities because of the nature of student participation involved. Having authority to make unique contributions to the projects, students have opportunities to author themselves in particular ways that position them for public recognition of their developing knowledge and skills. As they work collaboratively through the projects, they hold each other accountable for using disciplinary skills and practices, which can also work to position students as increasingly knowledgeable. These kinds of opportunities for agency in learning and problem-solving provided by the PBL learning context can support students' connections to the relevant practices and contribute to the thickening of their academic identities (Holland & Lave, 2001).

By studying students' identities in increasingly diverse AP STEM classrooms taking a project-based approach to instruction, this study aims to gain insights into the ways in which students develop academic identities in high-stakes heterogeneous evolving contexts.

Understanding these processes may help explain the outcome discrepancies among students from groups who have traditionally enrolled in AP STEM courses and those who have not.

Additionally, studying identities in a PBL AP STEM course should shed light on what aspects of PBL might facilitate the development of AP STEM-related identities.

## **Chapter 2: A History of the College Board Advanced Placement Program**

In this chapter, I historicize the AP Program to give some social and historical context to this study<sup>3</sup>. In doing so, I bring to view the College Board’s agenda for the AP Program, and the social patterns that have followed the Program to its current state. Different from developing identities in Science (e.g. Barton & Tan, 2009; Carlone & Johnson, 2007; Barton et al., 2012), there is little literature to connect the AP program with identity work. Therefore, this chapter provides the landscape against which the students in this study build their AP identities. I begin with describing the relevant ideas in education prior to the development of the AP program, and the contextual factors contributing to its creation. I then describe the formation and growth of the program, including some of the greater social and cultural factors influencing its trajectory. I end with a description of the current state of the AP program, offering more detail than described in the preceding chapter. In providing this historical backdrop, I hope to illustrate the dynamic nature of the ever-evolving AP Program, its potential for change, and convey the complexities that may be involved in identity work in this context.

### **Attention to “Giftedness” in the Early 1900s**

Prior to the Advanced Placement Program’s mid-century inception, students who were ‘advanced’ or ‘accelerated’ were systematically attended to. In the first part of the twentieth century, there was a focus on “*enrichment* and *ability grouping* for better students” (Lacy, 2010, p. 20). This early system of tracking (National Education Association, 2017), in which students with high IQ scores were deemed *gifted*, students were separated from their peers in specially developed schools or along separate courses of study (e.g. vocational v. college preparatory) (Gallagher, 1994; National Association for Gifted Children, n.d.). Students’ IQ’s

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<sup>3</sup> Interestingly, there is a dearth of literature on the history of the AP program. Thus, I draw heavily on the reports by Lacy (2010) and Rothschild (1999).

were assessed using Binet-Simon or Stanford-Binet tests, which were subject to hidden interests and biases (Ryan, 1997). Although some select students were granted a particularly tailored education on the basis of these tests, the tests were also used to support claims made in the eugenics movement, which promoted racial segregation, immigration restriction, and forced sterilization of those believed to be ‘feeble minded’ (Ryan, 1997; Kindregan, 1966; Hansen & King, 2001).

In the 1920s, schooling for gifted students followed the progressive education movement. Progressive education philosopher John Dewey believed in a practical child-centered approach to education in which intellect and social development were inextricably linked (Dewey & Small, 1897). In this Dewey-inspired model, gifted students were to “move through the grades with their peers but follow an enriched curriculum” (Lacy, 2010, p. 21). Although students were kept with same-aged peers, schools maintained ability- or intellectual-based groupings. However, these programs of gifted or enriched education existed within the segregated school model and were only available to those in the privileged schools (Tassel-Baska, 2010).

Following this period of progressive education, “progress in advanced placement thinking was stunted by the economic woes of the Great Depression and the distractions of World War II” (Lacy, 2010, p. 21). Then, in 1945, a Harvard Report was published titled *General Education in a Free Society*. The issue it tackled was general education and what all students need to know to be able to function in a democracy – a sort of precursor to the Common Core, to draw a metaphor. It denounced much of the progressive education philosophy as overemphasizing vocational programs and specializations. Importantly, “the report helped shape future discourse about advanced placement by limiting the [AP] program

to survey courses that could form the core of a general education curriculum” (Lacy, 2010, p. 22).

### **Founding the College Board**

It was also during early 20<sup>th</sup> century that the College Board was established. The Board was initially an association of members from elite northeastern colleges with the purpose of writing, administering, and scoring college entrance exams. The board grew rapidly to include thirty-three colleges by 1920, testing thousands of students, leading to the development of the SATs (Lacy, 2010).

Following WWII, colleges experienced a large influx of students using the tuition assistance provided by the GI bill. To make the college admissions and placement process more efficient, colleges used SAT scores in addition to grades, creating opportunities for students to transition to college faster (Lacy, 2010). During this time, the Educational Testing Service (ETS) was established and became the administrator of the College Board’s SAT and GRE exams.

### **Mid-Century Initiatives**

In the early days of the Cold war, discussions among educators about general education emphasizing college admissions and testing foreshadowed the GI Bill spike in college enrollment. Concurrent with anticipating these enrollment trends, many educators maintained interest in their gifted students and the quality of their education. This was articulated in the release of two relevant reports, *Education of the Gifted* (1950) and *The Gifted Child* (1951). In general education discourse, there was concern that, if our human potential was not capitalized on, then the United States would become susceptible to the ‘evils’ of communism. We needed to get the large number of students attending college

through their course of study more efficiently, in particular those who were to become the engineers and scientists of the future (Rothschild, 1999).

In response, the Ford Foundation's Fund for the Advancement of Education (FAE) supported several programs for advancing qualified high school students to college in the early 1950's. In one, a committee formed of elite preparatory school and university faculty with the aim of outlining a course of study for the most "superior" students in school. The committee claimed that, "This concern is partly the result of our belief that standards can be pulled up from the top more easily than they can be pushed up from the bottom" (as cited in Rothschild, 1999). In the conclusion of the committee's report, they called for: (1) a core curriculum to balance student class choices; (2) flexibility for students to excel in particular subjects; (3) a series of exams that would allow give students entering college credit for prerequisite or entry-level courses (Lacy, 2010; Rothschild, 1999). Points two and three were especially influential to the AP program.

Another of the FAE's programs to note was the Kenyon Plan. This was initially headed by the president of Kenyon College, and was based on the following premises: (1) gifted students can do college-level work while in high school if (2) teachers are appropriately trained to teach them, because (3) high school is the best social setting for adolescents (Lacy, 2010; Rothschild, 1999). In this program, students took achievement tests in different subjects that were the pilot versions of what became the AP exams.

### **Launch and Growth of the AP Program**

In 1954, the College Board took over the Kenyon Plan and ETS administered the first official AP tests. The first tests cost ten dollars and were graded on a five-point scale. The AP exams continue to be scored out of 5, with a passing score of 3.

Although the official launch of the AP program coincided with *Brown v. Board of Education*'s end of *de jure* segregation in schools, the College Board was not putting its efforts into equity in the AP program. Rather, the College Board was "introducing the program as widely as possible to upper-and upper-middle-class public and private schools" (Lacy, 2010, p. 32). It has been well-documented that these schools largely maintained *de facto* segregation long after the *Brown* ruling.

The launch of Sputnik in 1957 fueled the push for higher standards in high school, and boosted the popularity of the AP program. The "race for space" positioned engineering, math, and science as particularly important fields of focus. This, in combination with increased attention to juvenile delinquency, encouraged, "a general U.S. social environment of conformity, consumerism, containment, and consensus about behavioral norms" (Lacy, 2010, p. 33). In education, universities were actively seeking those who excelled in school, especially in science and math. This was reciprocated with steadily increasing participation in AP throughout the 1960's, although growth continued to be within the top stratum of achieving students (Lacy, 2010).

### **Ebbing and Flowing Tides**

In the early 1970's the AP program was rattled by factors in the social milieu. Growth in participation stalled and test scores dropped significantly. Scholars Lacy (2010) and Rothschild (1999) suggest that this was likely a backlash against elitist education. Rothschild writes, "Top-flight American education had always been elitist, and the democratic trends of the sixties called for better education for the many, rather than the best education for the few" (p. 185). Political activism was on the rise in schools, and students were calling for the abolishment of grades and formal exams, and an increase in individualized education. In

addition, people noticed the racial disparity in the AP program, and began to call it out as a system of institutionalized racism (Rothschild, 1999).

The College Board responded to this dip in participation and criticism of its test format with a two-pronged approach. They introduced new tests in liberal arts such as music, French, and art history. They also changed some of the existing exams to include document-based questions that asked students to evaluate documents embedded in the exams, which did not rely on content covered (or potentially missed) in preparatory courses. By the mid 1970's the AP program had not only recovered from the early part of the decade, it had returned to a healthy growth trajectory (Lacy, 2010; Rothschild, 1999). However, the College Board struggled to sustain the program financially, despite regular increases in exam fees and the addition of a registration fee.

AP growth steadily rose through the 1980's and 1990's. In 1983, *The Nation At Risk* report once again raised public concerns over the state of the country's education system. In the report, the education crisis was again framed as an issue of national security: "The educational foundations of our society are presently being eroded by a rising tide of mediocrity that threatens our very future as a nation and a people" (A Nation at Risk, 1983). Among suggested remedies for the education crisis, the AP program was featured as a program of high quality that would save students money in college. The program gained a prominent face in the education and popular culture landscape through features in magazines, newspapers, the blockbuster movie *Stand and Deliver* (1988), and even a half-hour long promotional movie titled *A Chance to Excel* in the early 1980s (Rothschild, 1999).

### **Moving Toward Equity**

Asserting that the AP program was, "an effective instrument for serving gifted but

socially disadvantaged students” (Rothschild, 1999, p. 190), the College Board president described the AP program as a way to change negative stereotypes. During this time, the College Board promoted “a substantial movement toward racial, ethnic, national, and age democratization among examinees” (Lacy, 2010, p. 35). Not only did the program expand to more schools, including urban poverty-impacted and rural schools, it was adopted internationally. By 1994, fifty countries hosted AP exams (Lacy, 2010; Rothschild, 1999). Tests were continually added in various disciplines including Spanish, Drawing, Computer Science, Statistics, and Environmental Science (Lacy, 2010; Rothschild, 1999). The increase in AP students and number of test options was accompanied by increases in testing fees, and the AP program quickly changed from an economic burden to a source of significant revenue for the College Board (Lacy, 2010).

### **Recent Leadership Directions**

In 1999, the College Board acquired a new president, Gaston Caperton, marking a distinct move toward a corporate model. By 2009 the exam fee had ballooned to \$86 per test. It was estimated in 2008 that the revenue of AP was over \$232 million, which was almost half of the entire College Board’s overall revenue (Lacy, 2010). Although Caperton was an education advocate, supporting initiatives such as changing the SAT to better reflect student course work, and improving equity of access to AP, his and his staff’s high salaries drew criticism and questioning of the College Board’s function as a non-profit and the motives behind increasing participation in AP (Lacy, 2010).

Caperton left the College Board in 2013 to work at a private equity firm and was succeeded by David Coleman. Carrying on the legacy of Caperton, “melding a market orientation with a traditional, authentic liberal concern for education” (Lacy, 2010, p. 39),

Coleman is an education advocate with a history of founding community service programs for inner-city youth. He has a background in test development and worked as one of the key developers of the Common Core State Standards. Coleman also owned a profitable consulting firm after founding and selling a successful education data and assessment company. He was noted in Time Magazine as one of the top 11 education activists of 2011 and as one of the most influential people of 2013 (College Board, 2015, “Leadership”; Bush, 2013; Rotherham, 2011). In keeping with our current culture of standardized testing, economic growth, and education reform, Coleman segued into his current position.

### **The Current State of the AP Program**

As the AP program continues to broaden access to its programs through movements such as “AP for all,” the focus has returned to a heavy emphasis on science, technology, engineering, and math (STEM) (Advances in AP, “STEM”). Reminiscent of the Cold War spotlight on these subjects in an effort to strengthen our position on the global stage, the AP program has trimmed some of the liberal arts exams and pumped energy and funds into its 2013 STEM initiative.

The graduating student population is not keeping up with the explosive growth in STEM jobs. This slice of the job sector tends to be primarily occupied by Asian and White males. “African-American, American Indian/Alaska Native, Hispanic/Latino and female students in the U.S. are less likely to study math and science in college or pursue related careers than their counterparts. As an example, although females were awarded 57 percent of the 1.7 million bachelor degrees in 2009-2010, they only received 17 percent of engineering degrees, 18 percent of computer science degrees, and 41 percent of science degrees, according to the National Center for Education Statistics” (AP Central, “AP STEM Access Program”).

The AP STEM access program provides monetary incentives for teachers who diversify their AP STEM test takers by an increase in five underrepresented minority or female students each year (AP Central, “AP STEM Access Program”).

These efforts to expand the AP program have been economically fruitful. Over the past decade, the number of AP test takers has nearly doubled to over 1 million students taking over 3 million exams. The number of low-income participants has more than quadrupled to nearly 300,000 students (College Board, 2014a, “AP 10th Annual Report to the Nation”), with test fees paid for in part by grants. At nearly \$90 per test, one can imagine the soaring profit margin of the College Board. However, the number of low-income students passing their exams is surprisingly low. “Very few low-income students are earning college credit or advanced placement” (ETS, 2008, “Access to Success”, p. 21). In a 2008 analysis conducted by the ETS, only 1.3 percent of low-income students from large urban schools who participated in the AP exams passed the tests (ETS, 2008, “Access to Success”).

Despite efforts to broaden AP access by “eliminate[ing] barriers that restrict access to AP for students from ethnic, racial, and socioeconomic groups that have been traditionally underserved” and “make[ing] every effort to ensure their AP classes reflect the diversity of their student population” (College Board, 2015, “Achieving Equity”), gaping inequities persist within the program. “Nearly three-fourths of Black students failed their exams in 2011, along with 58 percent of Native Americans and 60 percent of Hispanics” (Smith, 2012, para. 6). The number of low-income students taking AP tests and courses has risen sharply, but “Very few low-income students are earning college credit or advanced placement” (ETS, 2008, “Access to Success,” p. 21). In a recent analysis conducted by ETS, only 1.3 percent of low-income students from large urban schools who participated in the AP exams passed the tests (ETS,

2008, “Access to Success”). The AP program, renowned for its academic rigor, is an education giant that is a complex system replicating patterns of inequity, despite putting forth goals to resolve these issues.

## **Conclusion**

The story of the AP program and its role in our current educational context has implications for social constructions of who belongs in AP, and what the purpose is for AP classes. Depending on several factors discussed in this study, the answers to those questions vary considerably. In the next chapter, I will share the theoretical literature that frames this dissertation.

### **Chapter 3: Theoretical Framing of Identity**

In this chapter, I review the theoretical literature on identity that informed this study. I used sociocultural and situative theories of identity because they align with conceptions of identity as developing through an individual's practices situated within and across particular contexts (Holland, 2009, Holland & Lave, 2009; Lave & Wenger, 1991; Dreier, 1999). In this study, I focused on the project-based AP Environmental Science learning context and the actors and artifacts within it. This theoretical lens is well-suited to explore students' AP and Science identities because the ways in which students understand and identify with AP and Science are informed by the local and historical contextualized definitions of these domains and their associated practices. Students come together in the PBL APES context in which they potentially have opportunities to develop and become competent with associated practices, and, in turn, develop related identities. Understanding the ways in which students in the PBL APES class socially identify with AP and Science could be a starting place for widening the door of opportunity for underrepresented students in AP sciences to develop connections with these practices, and continuing on a corresponding trajectory into their futures.

The identity-in-practice perspective views identity as a set of choices and practices that are continually under negotiation based on the "resources one has access to and the social, cultural, and historical context in which one seeks to author oneself with and against the expectations of others" (Barton et al., 2012, p. 38). This conception of identity as a process of negotiation takes into account the role of local and sociohistorical context, allows space for individual agency, and attends to the interplay between them. In other words, identity doesn't passively "happen" to people, nor is it a psychological "destination" arrived at in a contextual

vacuum. Rather, it is an active, interactive, ongoing process. The following text describes this theoretical perspective and the conceptualization of identity that anchored this study.

### **A Dynamic Identity Framework**

There is an important interaction between identity work and the social, cultural, and historical context within which the work is situated (Turner & Nolen, 2015). In a situative approach to identity, the individual is accounted for along with the contextualized moment in which the person is being considered (Dreier, 1999). Through this theoretical lens, identities are multiple, subjective, and positional (Holland et al., 2003). As Faircloth (2012) writes, “the way individuals come to understand themselves is continually negotiated and constructed through what is made possible or necessary amid the daily practices, encounters, discourses and struggles available to them within a particular context” (p. 187).

Rather than understanding identity as an *outcome*, this theoretical stance understands identities as the flexible and shifting ways in which people negotiate how they position themselves, and are positioned by others, in the contextualized moment (Holland et al., 2003, Holland & Leander, 2004). From this perspective, who one was, is, and will be is shaped through “encounters between people as they address and respond to each other while enacting cultural activities under conditions of political-economic and cultural-historical conjuncture” (Holland & Lave, 2009). Because this process brings together dynamic blends of histories-in-person, local norms and expectations, and historically institutionalized struggles, “its outcomes are always uncertain and gain new meaning as they get traced in time” (Barton et al., 2012, p. 41).

Of particular importance to this theoretical perspective is the role of social context in the work of identity negotiation. Identity theorist Dreier (1999) writes, “It remains to be elaborated and detailed into a richer and more concrete and lively understanding of the person,

paradoxically, not by looking directly ‘into’ the person, but into the world and grasp the person as a participant in that world” (p. 32). The AP program and STEM-related disciplines are contextual sites in which students encounter long-standing cultural-historical educational narratives and expectations about what it means to be smart, advanced, scientific, promising, a girl, a boy, an immigrant, Black, White, and so on. In the project-based AP Environmental Science context, students have the opportunity to engage in practices that can disrupt these paradigms, negotiating and renegotiating what it means to participate in AP sciences. Project-based learning positions students with authority to address problems and have agency in their learning, providing a unique learning context in which students might have opportunities to actively explore new identities. Studying the ways in which students participate in the practices of the PBL APES learning environment can contribute to theoretical discussions about school and science related identities, and the processes through which identities develop and inform each other. As the AP program strategically expands its population, and places increased emphasis on the STEM disciplines, students in the PBL APES classrooms concurrently negotiate their AP and Science identities while navigating the changes in the AP program and conceptions of Science.

### **Figured Worlds**

In examining how identities are negotiated within and across contexts, Holland et al.(2003) use what they coined the “figured world” as an analytical tool to contextualize identities. Figured worlds are the contextual “horizon of meaning against which people, acts, artifacts, and one’s selves are interpreted by self and other” (Holland, 2009, p. 270). Identities in these worlds develop through cultural processes that shape and are shaped by an evolving sense of who we are and who we can become. These “figured worlds and the identities of the actors

who populate them are always undergoing transformation in practice” (Holland, 2009, p. 271). People are actors in multiple worlds simultaneously, and the worlds overlap and intersect through time and space. For example, a high school student may be concurrently an actor in the cultural worlds of the high school, an after-school job, and an online gaming community (this list is neither exhaustive nor exclusive). The “AP world” and the “Science world” are two such figured worlds.

Certain aspects constitute a figured world. There exists a “shared repertoire” (Wenger, 1998) of recognized practices that actors engage in, language that actors use, and artifacts that are employed on a regular basis. In each world there are also the aspects of, “power, status, relative privilege, and their negotiation” (Holland et al., 2003, p. 125). The AP and Science worlds host their own variants of each of these aspects.

In the AP world, there are culturally normed practices of assigning (and completing) arduous amounts of homework, teaching as test preparation, studying for many hours, talking about stress, planning for college, and feeling challenged (Lacy, 2010; Paek, Braun, Ponte, Trapani, & Powers, 2010; Sadler, 2010). For many, acting in the AP world involves becoming fluent with “doing school,” in a culture that emphasizes grades, achievement, and diligence (Pope, 2001). Common AP discourse also includes ideas about being elite, smart, saving money in college, and earning early college credits (Duffy II, 2010; Klopfenstein, 2010; Sadler, 2010). The actors in this world have traditionally been identified as highly capable in some way (e.g. high test scores, by school counselors), and have also primarily included a fairly privileged group of students (Lacy, 2010; Rosthschild, 1999).

As the doors to AP have recently widened, the actors in the AP world have changed. These new students populating the AP landscape are part of a cultural shift in the construction of

the AP world. Negotiating the change has surfaced questions about what is happening to AP content and instruction in response to the demographic changes. If anyone can take AP classes, then the AP world might be at risk for losing its elite status. In an essay in *The Atlantic* magazine, a former AP teacher from a school that had opened access to its AP program wrote that, “Two thirds of the students taking my class each year did not belong there. And they dragged down the course for the students who did” (Tierney J., 2012). The director of research at the Education Trust, a nonprofit group, was quoted in the New York Times as saying, “Many teachers don’t truly believe that these programs are for all kids or that students of color or low-income kids can succeed in these classes” (Rich, 2013, A1). An online source for college preparatory textbooks and classes goes as far as to claim that having open access to AP classes puts so much pressure on students who don’t belong in them that they, “turn to drinking, partying hard, and smoking as ways to alleviate the pressure” (Lenson, 2012). These examples from popular culture illustrate the power of the divisive cultural forces that shape the way people think and react to major policy shifts toward diversity and inclusion.

On the other hand, this change also might open people’s minds about who has the potential to thrive in a rigorous learning environment. The focal district for this study advertised on the AP FAQ page of its website that, “Schools that make Advanced Placement accessible to all students usually experience the benefit of higher standards throughout the entire school.” This sends the message that AP for all does not only benefit those who have been historically marginalized from such opportunities, but that *all* students gain from this action. A MOOC course website encouraged all students to take AP classes because, “Whether you decide to take the AP exam for college credit or not, you will certainly not regret challenging yourself in your AP classes, and you’ll feel better prepared for college” (Sacks, 2015). This implies that AP

classes will benefit all students who are seeking rigorous learning. These contrasting views on who belongs in AP classes and the role of the AP program in education demonstrates the state of upheaval in the AP world.

Also changing is the Science world.<sup>4</sup> Science is a broad term, and the Science world varies across cultures. In the Western Science world, captured in Mazzocchi's (2006) description that echoes numerous scholars' sentiments on different occasions as, "analytical and reductionist," "positivist and materialist," "objective and quantitative," and "academic and literate," are the qualities of the practices and assumptions that are its hallmark. Contrast this with, for example, a Science world that includes practices of Indigenous Science (Ogawa, 1995) or Traditional Ecological Knowledge (Snively & Corsiglia, 2001) in which social cultural and environmental contexts are integrated into the understanding of phenomena. Most often in U.S. schools, the Western Science world is reflected in the organization and content of science curricula (Pomeroy, 1994). Not unlike the AP world, the widely adopted Western Science world is changing in schools. Scholars and scientists have, for years criticized exclusively adopting this perspective, and encouraged the widening of a space for transformation and dialogue between Science worlds (e.g. Aikenhead, 1996; Aikenhead, 1997; Aikenhead, 2001; Bang, Marin, & Medin, 2018; Mazzocchi, 2006; Ogawa, 1995; Snively & Corsiglia, 2000). By the mid-nineties, science had been well-established as a controversial discipline and body of knowledge, "There have been numerous studies and remedies addressing the needs of diverse learners in science education under the rubric of multicultural, intercultural, or cross-cultural education" (Pomeroy,

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<sup>4</sup> To fully engage with the large body of literature that discusses science in the ways addressed here (e.g. changing meanings of science, Western science versus indigenous science, science in schools) is beyond the scope of this literature review. I selected several well-known references to support this section of this dissertation, but also acknowledge that there is a great deal of relevant literature that could be appropriate to include here.

1994). Decades later, the debate continues, contentious as ever, in classrooms throughout the United States (e.g. Bang, Marin, & Medin, 2018; Meyer & Crawford, 2011; Lee, Yen, & Aikenhead, 2012). The historical debates surrounding science and the validity of particular *kinds* of science need to be accounted for when considering students' Science identities and related trajectories.

### **History-in-Person**

The history-in-person is “the sediment from past experiences upon which one improvises, using the cultural resources available, in response to the subject positions afforded one in the present” (Holland et al., 2003, p. 18). Drawing on literary analyses of Bakhtin, Holland and Lave (2001), consider the existence of actors in time and place in relation to embodied cultural and political conflicts. The history-in-person is the surfacing of these embodied struggles in identity-making moments that occur at the site of local contentious practice. History-in-person works to inform identity by colliding, “with combinations of circumstances that are by degree precedented and unprecedented. The behaviors, the products of the moment, then become available as mediators to change oneself and others, and perhaps even the figured worlds in which one acts” (Holland et al., 2003, p. 46). The extent that one identifies with a particular figured world relies to some extent on one's history-in-person and the way in which it is manifested in social practice. The underrepresented students in AP sciences encounter the AP and Science worlds with historically prescribed social positions, combined with their personal experiences, that inform the ways in which they interact with the other actors and artifacts in those worlds.

Actors in the AP and Science worlds embody past experiences and historical institutionalized social cultural structures and struggles, acting through them as representation of their histories-in-person, crafting their identities (Holland & Lave, 2001; Holland & Lave, 2009).

AP science classes bring the two worlds together in the learning context. The ways in which these classes are enacted can position underrepresented students in ways that either perpetuate or disrupt historical patterns. In these classes, students have opportunities to act in either or both of these worlds at a given moment, during which histories-in-person are brought to view in acts of identification. Project-based learning is structured so that students are positioned to be publicly recognized for their developing skill set, which can disrupt historical patterns as students have more opportunities to actually engage with AP science practices than they would in a lecture-test model of teaching and learning. As students engage in the practices presented by the PBL APES curriculum, their histories-in-person mediate the ways in which they construct their AP and Science identities and make meaning of the AP and Science worlds, both long-standing sites of struggle involving race, class, and social privilege, that they inhabit.

### **Agency**

From a socio-cultural and/or situative theoretical perspective (Nolen & Ward, 2008), people are *actors* in figured worlds (Holland, 2003). In that sense, their involvement in these worlds and their identification with them is not a passive experience. Exploring identity through this lens focuses on participation, “especially our agency, in socially produced, culturally constructed activities” (Holland et al., 2003, p. 40). Thinking about identity in this way allows for both the contributions of context and also individual choice in response to the context. A person can and does author one’s self amidst the other actors and aspects of a particular figured world. Having agency gives actors the power to make meaning of their worlds, and the artifacts and actors in it. Gee (2001) described the implications for variation in meanings made through agentic identity development processes when he wrote, “People can actively construe the same identity trait in different ways, and they can negotiate and contest how their traits are to be seen

(by themselves and others)” (p. 108).

Actors position themselves and are positioned by others as they negotiate multiple contexts. Positioning is an “event of social identification” (Wortham, 2004a, p. 166), during which, “individuals and groups get identified as instances of publicly recognized categories of people” (Wortham, 2004b, p. 4). Positioning can be intentional or subconscious, explicit or implicit, an action performed by the individual or other actors. For example, when Person A asks Person B for help with her PBL APES homework, Person A has positioned Person B as an authority on the subject, possibly an AP “veteran.” Person A has also positioned herself as someone who needs help, perhaps incapable of doing the work on her own. Actors move through figured worlds in relation to, other actors, and their perceived sense of place in that world (Holland et al., 2003). In the PBL APES classroom, students are actively working to socially position themselves in particular ways. The project-based structure of the course was intended to open opportunities for students to engage in social positioning moments that could potentially thicken (Wortham, 2004b), their AP and Science identities.

### **Practice-linked Identities**

Nasir & Hand (2008) also drew on prior conceptions of social practice theory to develop the framework of *practice-linked* identities used to analyze the connections between the self and the activity in which one is engaged. As described, social practice theory, “emphasizes processes of social formation and cultural production” (Holland & Lave, 2001) that happen when people engage particular practices that have been ascribed particular contextualized meanings. Specific to this particular theoretical framework, “Practice-linked identities are the identities that people come to take on, construct, and embrace that are linked to participation in particular social and cultural practices” (Nasir & Hand, 2008, p. 147). Having access to a domain, an integral

participatory role, and opportunities for self-expression, to make a unique contribution and feel valued facilitate the development of a practice-linked identity

According to Nasir & Hand (2008) practice-linked identities are “shaped by the nature of engagement that is afforded and constrained within the features of the practice” (p. 147). The engagement afforded and constrained by participating in the practices of the PBL APES course contributes to students’ AP and Science-linked identities. A learning context that supports engagement in the practices of AP and environmental science is likely to support a sense of connection between the self and these practices.

In a classroom using a project-based approach to learning, students are potentially more likely to have opportunities to take on integral roles, access the domains of AP and Environmental Science, and have opportunities for self-expression in practice than in courses taught using a transmission model of instruction (Cobb, 1988). The transmission model is one in which teachers deliver content, largely using lectures, and students are responsible for understanding that content, which is reflected in their test scores. In having the authority to take unique approaches to solving problems, students in a PBL classroom also acquire integral roles through which they hold each other accountable to disciplinary norms. In addition to providing opportunities for student authority and accountability, project-based learning can connect the learning with students’ real-life experiences, and supports collaboration with others (Bell, 2010). For students who have been historically marginalized from AP sciences, a project-based learning environment could better support their connection to AP and Science practices and the development of related identities.

## **Operationalizing Identity with the Science Identity Model**

Other researchers have conceptualized the aspects of domain-specific identities in similar ways. Carlone & Johnson (2007) developed their model of Science identity to understand the ways in which successful women of color experienced, negotiated, and persisted in science, and to operationalize identity. They acknowledge the concept's "unwieldy nature," and decided to focus on the importance of participation. Carlone & Johnson attend to three dimensions of a Science identity: competence, performance, and recognition:

One cannot pull off being a particular kind of person (enacting a particular identity) unless one makes visible to (*performs for*) others one's *competence* in relevant practices, and in response, others *recognize* one's performance as credible (p. 1190)

While Carlone & Johnson specifically attend to Science identities, the dimensions of identity that they call attention to can translate to other domains, in this case, AP. To develop an AP and Science identity, and be positioned in a particular way that identifies one with AP and Science in the PBL APES context, one would need to be recognized for the performance of one's competence in the practices of both AP and environmental science. Students can have opportunities for self-expression through performance of competence. In recognizing and valuing students for their competence, students hold each other accountable to the norms of the environmental science discipline. In the PBL classroom, there may be increased opportunities through projects for students to gain competence (through deep and meaningful learning experiences), make that competence visible (through the process and products of the project), and be recognized for their competence (by the teacher and other students), more so than in a traditional lecture and test course. Potentially, students can develop Science identities without

developing AP identities, and vice versa. This analysis considers performance, recognition, and competence in both domains.

### **Research Questions**

A project-based approach to AP Environmental Science can cast students in authentic roles from which they are charged with finding scientifically based solutions to environmental problems. Thus, students may have meaningful opportunities to construct Science identities as they make connections between course content and their own lives. In an AP class, they do this work using college-level skills and practices, which simultaneously contributes to the negotiation of AP identities that may inform students' post-secondary plans.

A study of identity development in this context can contribute to the theoretical discussions that use identity as a lens for analysis by examining how multiple identities (AP and Science) are simultaneously negotiated, and considering the implications of these ideas for designs of project-based learning environments. This study may also inform the development of programs to improve equity of access and outcomes in historically inequitable advanced STEM courses. For these purposes, I propose the following research questions:

1. How do students develop AP and Science identities in a project-based AP Environmental Science (PBL APES) course? What opportunities and constraints do students experience for the development of AP and Science identities in the PBL APES course? In what ways are these opportunities and constraints related to the changing nature of AP and Science?

2. How are the aspects of identity development experienced in the PBL APES class related to students' possible futures in AP and Science? How are students' identity trajectories informed by the interaction of histories-in-person with their local participation in the PBL APES class?

The first research question aims to address a literature gap by exploring identity development in the project-based learning context. There is a large body of research on identity, including science-related identity, in general education contexts and extracurricular learning environments (e.g. Brickhouse & Potter, 2001; Barton & Tan, 2010; Nasir, 2011). There is also substantial research on project-based learning and students' learning, achievement, motivation, and engagement (e.g. Blumenfeld et al., 1991; Darling-Hammond et al., 2008), including studies conducted in the Advanced Placement classroom context (Parker, et al., 2013), but little that addressed the mechanisms and structures in PBL that may contribute to students' identity development, specifically in the AP sciences. In this context with a history of social inequity and a reputation for exclusiveness, PBL might offer opportunities for students who are only marginally familiar with this context to explore the practices of AP and Science, and begin to develop related identities.

The second research question addresses the notion that the development of students' AP and Science identities "might eventually involve changes in their more enduring sense of who they are and who they want to become" (Carlone & Johnson, 2007, p. 1189). When students engage in particular practices, their related identities can thicken as they are increasingly associated with those practices (Wortham, 2004b; Holland & Leander, 2002). This has implications for their possible identity trajectories (Dreir, 1999; Wenger, 1998). A high school

student with thickened AP and Science identity can be considered as developing an identity trajectory toward a related future identity, such as pursuing a science major. This has practical implications as noted by the College Board who reported that students who take AP STEM course are more likely than non-AP students to earn degrees in STEM disciplines (AP Central, “AP STEM access program). Therefore, it is important to consider not only students’ identities in the moment, but the potential for their identities in the future.

## Chapter 4: Research Methods

### Study Design

The study uses a mixed methods approach, which offered several advantages, despite some disagreements among scholarly researchers about the compatibility of methods (Teddlie & Tashakkori, 2003). Qualitative methods can expand and develop theory and conceptual frameworks, seeking to understand meaning, and quantitative methods can test theory and find correlations and causal relationships, but the two do not necessarily have to operate independently. “The qualitative-quantitative linkage through a hybrid (mixed) design demonstrates the interactivity and interdependence of these components of reflective inquiry” (Rocco, Bliss, Gallagher, Perez-Prado, Alacaci, Dwyer, Fine, & Pappamihel, 2003, p. 599).

One major advantage of using mixed methods is, “that it enables the researcher to simultaneously answer confirmatory and exploratory questions, and therefore verify and generate theory in the same study” (Teddlie & Tashakkori, 2003, p. 15). Such an approach to research has high potential to provide better and stronger inferences, and opportunities for presenting a greater diversity of potentially divergent views that are valuable. In other words, (1) inferences drawn from mixed methods can confirm or complement each other, leading to a greater depth of understanding, and (2) divergent findings can illuminate unforeseen discrepancies and complexities, leading to deeper examination and understanding of theories. Prior studies on identity development that leverage social practice theory tend to be qualitative (e.g. Boaler & Greeno, 2000; Nasir & Hand, 2008; Tan & Barton, 2008). A mixed methods approach that includes both qualitative and quantitative analysis enhances the theoretical conclusions drawn from the research.

## Setting

The focal district for this study was an urban, poverty-impacted Midwestern district that had adopted an “AP for all” approach to expanding its AP program. In their AP teacher handbook, the district stated that it was, “committed to leading the way in the state of [omitted] and demonstrating success in creating a high-quality, AP program for all” (focal district AP teacher handbook, 2017, p. 3). When the data were collected, 74.8% of the students in the district received free and reduced lunch, and there were a large number of refugee immigrant families in the district. Since embracing “AP for all” four years earlier, the district had introduced a steadily increasing number of AP classes into *all* of its general education high schools, including schools that historically had little to no AP courses prior to this policy implementation.

Historically, most of the district’s AP courses were housed at a separate campus, rather than at the general education comprehensive high schools. Students who qualified for AP courses were bussed to the off-site AP location to attend those classes from their home high schools. Student applicants who scored in the top 10% of their standardized tests and maintained grades of As and Bs in all core classes were admitted to the program. The two comprehensive high schools that *did* offer AP courses were the two highest achieving schools in the district with the lowest free and reduced lunch rates, and they offered only 1-2 AP courses at each. Four years prior to this study, the district began a gradual process of introducing AP courses into all of the comprehensive high schools as one way to address conspicuous achievement inequities. This process continued each year with the goal of annually increasing the number of AP courses offered in each school, and increasing the number of students, particularly low-income students, enrolled in AP courses. Since the concerted effort toward “AP for all,” students throughout the

district had become increasingly familiar with the culture and rigor of AP coursework.

Introducing AP classes into schools with little to no history of Advanced classes created an opportunity for students in these schools to re-conceptualize the AP world as more inclusive than it had previously been considered. Students in all schools were encouraged to sample AP classes, even if they did not have a GPA that was historically a prerequisite for those classes. This disrupted the assumption that only the highest achieving students belonged in AP classes.

### **Curriculum**

Several of the district's new AP courses had adopted a project-based curriculum with the goal of teaching deeper learning to a broader demographic of students than a traditional lecture-test approach to AP instruction (Parker, Mosborg, Bransford, Vye, Wilkerson, & Abbott, 2011). This study was set in the AP STEM-based context of a project-based AP Environmental Science (PBL APES) course (Figure 1). In the context of the national AP program, AP Environmental Science was intended to be a rigorous lab science that would prepare students entering college to “to undertake, as first-year college students, a more advanced study of topics in environmental science or, alternatively, to fulfill a basic requirement for a laboratory science and thus free time for taking other courses” (College Board, 2013, p. 4).

The curriculum for this course was designed as part of the Knowledge In Action (KIA) project, a design-based implementation research collaboration that was initiated between the University of Washington, Bellevue (WA) School District, and Lucas Education Research, and which grew to include collaborative relationships with several districts across four states (Parker et al., 2013). In PBL APES, students took on roles in real-world or simulation “challenge cycles,” which were the vehicles for learning the AP Environmental Science content (Bransford & NRC, 2000). In this model, there is a course master question that underscores each project,

and is continuously revisited in different ways throughout the year. Key design principles that shaped the design of this and other KIA-developed PBL courses were: 1) projects as the spine of the course, 2) quasi-repetitive activity cycles ("looping"), 3) engagement that creates a "need to know," 4) teachers as co-designers and collaborators, and 5) an eye for scalability. This type of project-based curriculum is believed to be an effective way to approach AP course standards (Parker et al., 2013) while having students engage in deep and meaningful learning experiences.

Throughout each project cycle, students were tasked with answering a course master question, "How can we live more sustainably?" The cycles were ordered in such a way that students began the year by examining their own families' impacts on the environment in the project titled, "Eco-Footprint." Subsequent cycles were designed to gradually expand the students' spheres of influence, culminating in a simulated global climate summit. This arrangement of cycles was an intentional design move to maximize student engagement and development of environmental identities (Tierney, G., Goodell, Nolen, Lee, Whitfield, & Abbott (under review). The final design was a project-based AP Environmental Science curriculum that was engineered to provide multiple opportunities for students to connect with the practices of AP Environmental Science in meaningful ways that could potentially impact their identity trajectories. In this class, students learned and engaged with skills and practices of environmental science. Layered on to this were the scholarly skills and rigor of an AP class. Participating in both the figured worlds (Holland et al., 2003) of AP and Science, students potentially had opportunities to simultaneously develop identities related to both.

Figure 1. Course Poster



## Participants

Participants for the current study were selected from the population of consenting students enrolled in the KIA-designed PBL APES course taught in five comprehensive high schools in the focal district during the 2014-2015 academic school year. For the quantitative portion of this study, I selected all of the students from these high schools who participated in both the beginning and end-of-course surveys ( $n = 79$ ). For the qualitative portion of this study, I selected seven focal students from three schools who represented a range of demographics that characterized the schools that they attended (see table 1). All had participated in at least four of the following: beginning-year survey, end-of-course survey, first interview, second interview, targeted video recordings). The schools that I chose from were two of the most poverty-impacted schools, and the one most privileged school in the district. The teachers in these schools had a range of experience with teaching, teaching AP classes, and teaching PBL APES (Table 1).

Table 1. Participant and School Characteristics

TEACHER NAME & DESCRIPTION	SCHOOL & FRL RATE	STUDENT	1ST YEAR IN AP?	MOTHER'S HIGHEST EDUCATION LEVEL	RACE	GENDER	LANG. OTHER THAN ENGLISH SPOKEN IN HOME?	AGE AT BEG. YR.	PARENTS BORN IN ANOTHER COUNTRY?
<b>Ms. LaDuke.</b> 2nd yr teaching/1st yr. PBL APES. General Sci credential, BS Biology, BS Psychology	<b>Howard</b> 75% Free/Reduced Lunch	Farrah	Y	Elementary School	Black	Female	All or Most of the time	17	Both
		Iris	Y	Graduated College	Black	Female	Never	16	No
<b>Ms. Murie.</b> 3rd yr teaching/3rd yr PBL APES. General Sci credential, BA Chemistry, BA Linguistics	<b>Eaton</b> 79% Free/Reduced Lunch	Brandon	N	Graduated College	White	Male	Never	17	No
		Ramon	Y	Some High School	Latino	Male	All or Most of the Time	15	Both
		Marta	N	Advanced Degree	White	Female	Never	16	No
<b>Ms. Carson.</b> 7th yr teaching/3rd yr PBL APES. MAT credential, MS Sustainable Agriculture, BS Environmental Science	<b>Richland</b> 51% Free/Reduced Lunch	Erin	N	Advanced Degree	White	Female	Never	16	No
		Logan	N	Graduated High School	White	Male	Once in a while	16	No

Howard High School had a high number of students in poverty (75% free or reduced lunch). The teacher of the PBL APES class, Ms. LaDuke, was only in her second year of teaching, and in her first year teaching any AP class. The two focal students from Howard were both Black females from fairly different socio-economic backgrounds. Farrah was a senior and Iris was a junior during the year of this study. This was both of the students' first time taking an AP class.

Eaton High School was the largest school in the district, and also had a high number of students on free or reduced lunch (79%). The teacher, Ms. Murie, had taught the PBL APES class for all three of her years as a teacher. The three focal students from her class, Marta and Brandon were both White students from fairly privileged backgrounds. Ramon, a Latino male,

spoke primarily Spanish at home, and his mother had not completed high school. As a senior, Brandon had taken the most AP classes. Ramon, a sophomore, was experiencing PBL APES as his first AP class.

Richland High School had a long history of bussing students to their AP classes at the off-site location. With a free and reduced lunch rate of 51%, the school boundary encompassed the city's most affluent neighborhoods. The teacher, Ms. Carson, was the most experienced and credentialed of the three teachers with a strong content background and a graduate degree. The two students from her class, Logan and Marta, were both White juniors who were already veteran AP students.

### **Data collection<sup>5</sup>.**

Since identity work is an ongoing and constant process of participation and negotiation (Dreier, 1999; Wenger, 1998), collecting data over time can capture and illustrate these processes. Wenger (1998) states that an identity trajectory “has a coherence through time that connects the past, present, and future” (p. 154), and that, “A sense of trajectory gives us ways of sorting out what matters and what does not, what contributes to our identity and what remains marginal” (p. 155). Collecting data over time can provide sufficient information to understand students' identity negotiation in the moment, and also their possible identity trajectories. To capture this, three types of data inform this analysis: 1) beginning- and end-of-year survey data collected from all consenting students in the five high schools, 2) beginning- and end-of-year interviews with a subset of focal students, 3) video data collected throughout the school year of

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<sup>5</sup> Data for this dissertation was drawn from data collected for the Knowledge In Action project. While there were interview and survey questions and video recordings that bore directly on this study, the data was collected for purposes that were different from this dissertation. There were questions on the interview and survey protocols and video recordings that were not immediately relevant to my purposes. Using data gathered for these purposes restricted my data collection strategies to serving the larger project.

whole class and small group/ partner interaction with the selected focal students, and 4) document data of the PBL APES curriculum.

**Survey.** KIA-developed surveys (appendices A and B) were administered to all of the focal district's consenting students enrolled in the PBL APES course at the beginning and end of the 2014-15 academic year. Items on the surveys consisted of open-ended responses, rating scales, and categorical responses. The beginning-of-year surveys were used by the KIA research team to select focal students within each classroom to interview and video-record throughout the school year. Items relevant to this selection process included mother's education level, familiarity with the AP program, and languages (other than English) spoken at home, which were intended to capture the diversity of students enrolled the PBL APES course across the five high schools.

For the qualitative analysis, the survey items were used to triangulate information reported on the interviews and observed in the videos. Relevant items on the initial survey included information about reasons for taking the class, post-secondary plans, and intention to take the AP test. Relevant items on the final survey included information about perceptions of agency in the classroom, post-secondary plans, classroom participation, and resources. These data informed both research questions 1 and 2.

The survey items were also used for the quantitative portion of this study to learn if certain processes of identity development in the PBL APES course could predict students' intent to pursue STEM-related fields at the end of the year (research question 2). Items that informed this analysis focused on students' opportunities for self-expression characterized as agentic involvement, students' perceptions of their competence measured by a college confidence question, and students' post-secondary plans.

**Video.** Researchers, including myself, from the larger KIA project collected extensive video recordings of the PBL APES classes from the five schools throughout the 2014-15 school year. These data captured whole class, small group, and paired interactions of focal students. Using the video observation log that briefly summarized each instance of video recording, I created a table that captured the date, lesson, and type of interaction in each video. From that, I selected targeted video recordings to analyze that I believed would be most relevant to this analysis, based on high levels of participation by the focal students.

My final corpus of targeted video data (Table 2) showed students participating in the PBL APES classrooms, which allowed me to examine the ways in which students negotiated their identities in the practices of this learning context. I could also see what kinds of assumptions and biases were presented and manifested by the teacher, school culture, and other students. Observing through video brought to view the ways in which students' engagement in these classroom practices afforded or constrained their identity development (research question 1).

Table 2. Targeted Video Data Matrix

Project Cycle	Teacher	Task & Lesson	Whole Group	Small Group	Pair Work
Eco-Footprint	Ms. Murie	T1L1		X	X
		T1L4	X	X	
		T1L5	X	X	
		T3L1	X		X
		T3L1	X	X	
Food Systems		T2L1	X		
		T2L2	X		
		T4L3	X		
Oceans In Action		T4L2	X	X	
		T2L1	X		
		T3L1	X		
Eco-Footprint	Ms. Carson	T1L1	X	X	
		T1L4	X	X	
T2L1		X			
Food Systems		T2L1	X	X	
		T2L1			X
		T4L3	X		
Oceans In Action		T5L1	X		
		T1L3	X	X	
		T3L1	X		
		T3L2		X	
	T4L1		X		
		T6L1	X		
Eco-Footprint	Ms. LaDuke	T0L0	X		X
		T1L1	X		X
		T1L1	X		
		T3L1		X	
Food Systems		T2L3			X
		T3L1	X		X
		T3L1	X		X
		T3L2	X		X
		T4L3	X		X
		T5L1	X		X
Oceans In Action	T11L1	X		X	
	T1L3	X			

**Interview.** We collected audio-recorded interview data from the KIA focal students after completing the first project cycle, and again after they had taken their AP exams in the spring<sup>6</sup>. Interviews followed a semi-structured protocol (Merriam, 2009) that left room for flexibility in the order of the questions, depth of elaboration on topics, and for adapting the wording of questions to fit the interview context (appendices C and D).

Since I could not directly observe thoughts and feelings, or histories and memories, interviews offered valuable insights into the students' perceptions of their experiences. Bearing on research question 1, interview data both extended and triangulated the findings gleaned from the video analysis (Merriam, 2009; Patton, 2002) through self-reports of students' experiences in the class. The interview data largely inform research question 2 through the ways in which students discuss their post-secondary plans and any relationship between their experience in the PBL APES course and those plans, triangulating the findings from the quantitative analysis.

Relevant questions on the initial interview protocol were aimed at understanding how students perceived the project-based learning context, the AP world, future plans, and their understanding of the Science world. Examples of interview questions included, "How does this class compare to other classes you are taking?" "Who, in your opinion should take AP classes?" "As of now, what are your plans after high school?" and "What kinds of things tend to be easier or harder for you in science?" These questions offered insights into students' perceptions of the ways in which they were located in the PBL APES context, and their understandings of their identity trajectories.

The relevant questions on the end-of-year interview protocol were intended to shed light on how students' perceptions may have changed over the course of the year, and what may have

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<sup>6</sup> Due to attrition or issues with attendance, we did not interview all students in both the fall and spring of the school year.

contributed to those changes. Examples of these questions included “How, if at all, was this class different from other courses?” “Are there connections between this course and your plans after high school?” “How does this class fit with your ideas about AP, specifically AP science classes?” and “Has this class been a good fit for you (why or why not)?” Responses to these questions triangulated the other data sources and elucidated findings about students’ related identities.

**Documents.** The PBL APES curriculum was designed to offer students’ opportunities to perform their competence and be positioned in ways that would thicken their AP and Science identities. To understand the ways in which the curriculum afforded or constrained identity opportunities, I found it useful to analyze the curriculum itself (research question 1).

I selected three project cycles for analysis: Eco-Footprint, Food Systems, and Oceans In Action. These were the first, third, and fourth out of the five cycles that constituted the full curriculum. I selected Eco-Footprint because it was the first project that students encountered. For many, this was their initial experience with the skills and practices of environmental science, and students continually reported that this cycle was especially impactful. Five of the seven focal students said that this was among their favorite projects of the year, which they attributed to their personal connection to the content. It was also considered the most challenging cycle by five of the seven focal students (not the same five), which was related to the demands of college-level engagement with the content and skills of the course (e.g. data collection and analysis). I chose the Food Systems cycle because it was the first simulation-based cycle that students experienced. For the first time, they were to take on roles and address problems that they did not have direct contact with in their daily lives. This cycle was also noted as especially meaningful by three of the focal students, and also was considered especially challenging by four students. Oceans In

Action was also a simulation-based project. I selected this project because it was the last project that classes tended to complete prior to the AP exam, and, for many, the last project of the year due to time constraints.

## Chapter 5: Quantitative Analysis and Findings

### Quantitative Analysis

The quantitative portion of this analysis aimed to address research question 2, exploring whether certain aspects of identity development in the PBL APES course predict students' intent to pursue science-related fields at the end of the year. I focused this portion of the study on this aspect of agency in identity development (Holland, Lachiotte, Skinner, & Cain, 2003) as one possible predictor of future identity trajectories. Since Carlone & Johnson (2007) posit that competence is also one of the essential aspects of identity, I attended to this as another possible predictor of future identities. To address the research question, I analyzed whether students' perceptions of and agency and confidence that they would do well in college uniquely predicted their intended futures in science.

**Sample.** The sample for this study included 79 students who were enrolled in the PBL APES class for the 2014-2015 school year in the described focal district, and that participated in both the beginning- and end-of-year survey ( $n = 79$ ). During that academic year, there were a total of seven course sections across the five schools, taught by five teachers, one in each school. The responses to the described surveys constituted the sample for this analysis.

**Variables.** The study included the two predictor variables, Agentic Involvement (AgInv) and College Confidence (Conf), one binary outcome variable that reflected students' intended futures in science (SciFuture), and several control variables. The coding scheme for these variables is outlined in the upcoming analysis plan section. The predictor variable, agentic involvement, was assessed through a series of three survey questions that focused on student perceptions of their agency. These items were measured on a five-point scale (1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = strongly agree). The items stated: I actively

participated, I usually felt like I contributed to our learning, and I usually felt like my ideas were important to our learning. The second predictor assessed student perceptions of their competence, measured by a single survey item that asked, “How confident are you feeling about being successful in college?” This item was measured on a three-point scale (1 = not at all confident; 2 = somewhat confident; 3 = very confident). The outcome variable was an open-ended survey item that asked, “What career or field/s of study are you planning to pursue?” Responses to this question indicated if students intended to pursue careers or majors in science-related fields.

**Analysis plan.** Because I was predicting a binary variable outcome, I conducted a binary logistic regression analysis with sequential predictor entry (Tabachnick & Fidell, 2001) using *SPSS* to test if students’ perceived agentic involvement and confidence uniquely predicted students’ projections of their future careers/fields of interest. “Logistic regression allows one to predict a discrete outcome such as group membership from a set of variables that may be continuous, discrete, dichotomous, or a mix” (Tabachnick & Fidell, 2001, p.517). In this case, the group membership was whether or not students foresaw their future in science; specifically I coded responses to the outcome variable item related to science with a 1, and responses that were not related to science with a 0.

As a preliminary analysis, I checked to see if there was the possibility of a teacher effect on students’ future interest in science major or career (i.e., to ensure that the statistical assumption of independence would be maintained in my model). A chi-square test indicated that there was no evidence of differences among the five teachers,  $\chi^2(4, N = 79) = 5.25, p = 0.263$ . Thus, students’ teacher membership was not included in the logistic regression model to help maximize statistical power.

The focal predictor was an agentic involvement scale created from the three 1 – 5 point rating-scale questions ( $\alpha = .82$ ). College confidence was also a focal predictor measured with a 1 – 3 point rating scale. Both of these variables were then standardized into z-scores for the regression model for ease of results interpretation (and to create interaction terms).

Next, I selected three control variables to include in my model in order to isolate their effects on future science major/career interest from the effects of the focal independent variable (agentic involvement). These included beginning of the year career/field of interest, which was measured by a survey item that was a follow-up to the outcome variable (future science interest), asking if this plan had changed since the beginning of the year (which was then compared to their outcome and coded 1 = yes interested in science in the fall, 0 = not interested in the fall); students' self-reported [binary] gender (female = 1, male = 0)), and students' self-reported underrepresented minority status (1 = yes, 0 = no). In the literature all of these factors have been shown to be relevant to AP and STEM fields (AP Central, "AP STEM access program"). Each of these binary variables was then effect coded for the regression analysis.

In summary, Block 1 of the model included agentic involvement, college confidence, and students' self-reported gender, minority, and initial science interest status. and entered into the model in Block 1. However, since perceptions of agency are tightly linked with identities (e.g., gender), I also created all 2-way interaction terms between agentic involvement and each of the other predictors in order to see if agentic involvement's effect on future science interest was moderated by these factors. These interactions were grouped together as *agentic interaction* variables entered in Block 2.

The model I conducted was specifically as follows.

**Block 1:**

$$\text{Log(Odds of FutureSciInt)} = \text{intercept} + \text{ZAgentic} + \text{ZConf} + \text{FemEff} + \text{URMEff} + \text{FallSciIntEff}$$

**Block 2:**

$$\begin{aligned} \text{Log(Odds of FutureSciInt)} = & \text{intercept} + \text{ZAgentic} + \text{ZConf} + \text{FemEff} + \text{URMEff} + \text{FallSciIntEff} \\ & + \text{ZAgent*ZConf} + \text{ZAgent*Fem} + \text{ZAgent*URM} + \text{ZAgent*FallSci} \end{aligned}$$

**Logistic Regression Results**

The quantitative analysis of the survey data sought to understand the relationship between students’ perceptions of agency in the PBL APES class and confidence that they would succeed in college, and the likelihood that they would pursue a career or major in science (research question #2). To begin the analysis, I calculated the zero-order correlations to examine existing direct, one-to-one relationships among variables. As Table 3 shows, agentic involvement was not significantly correlated with the outcome variable ( $r = -.04, p > 0.05$ ), nor was it correlated significantly with any of the other predictors. There was one trend that revealed that initial science interest was directly related to future science career interest ( $r = 0.20, p = 0.079$ ). This said, the zero-order correlations only show direct, one-to-one relationships; the regression analysis will take into account all interrelationships among variables in the prediction of future science interest.

Table 3. Descriptive Statistics and Zero-Order Correlations

	<i>M</i>	<i>SD</i>	1.	2.	3.	4.	5.
Science career/major interest	0.32	0.47	--				
Agentic Involvement	3.44	0.71	-0.04	--			
College Confidence	2.59	0.52	0.06	0.14	--		
Underrepresented Minority Status	0.32	0.47	-0.05	-0.01	-0.05	--	
Female	0.52	0.50	0.17	-0.03	-0.12	0.11	--
Pre Science Interest	0.20	0.40	0.20	0.08	-0.10	-0.07	0.11

Note. *N* = 79 students from 5 schools. \* $p < .05$ , \*\* $p < .01$ .

The results from the binary logistic regression analysis with sequential predictor entry are provided in Tables 4 and 5 (recall that these are in log-odds, or logit values) for Block 1 and Block 2 (which includes Block 1), respectively. Results from Block 1 show that the set of predictors did not significantly predict the likelihood that students in PBL APES classes would be interested in pursuing a career or major in science ( $\chi^2(5) = 6.10, p = 0.297$ ). Nevertheless the model's hit rate was better (72%) than the null's hit rate (68%), and the approximate variance in future science interest accounted for by the set of predictors was 10% using Nagelkerke's pseudo- $R^2$ . Block 2, which added the agentic interaction variables, showed a significant improvement in the model fit ( $\chi^2(4) = 9.93, p = 0.042$ ) and had an improved classification rate (sensitivity was 36%, specificity was 96%, with an overall hit rate of 77%). Indeed, the full model with all nine variables compared to the null model with no variables showed a trend for significant fit to the data ( $\chi^2(9) = 16.03, p = 0.066$ , Nagelkerke's pseudo- $R^2 = 0.26$ ).

Table 4. Block 1 Logistic Regression Model for Predictor Variables

<i>Coefficients</i>	<i>B</i>	<i>SE</i>	<i>Wald</i>	<i>df</i>	<i>p</i>	<i>OR</i>
Z Agentic Involvement	-0.14	0.26	0.28	1	0.56	0.87
Z College Confidence	0.25	0.27	0.84	1	0.36	1.28
Underrepresented Minority Status	-0.16	0.28	0.33	1	0.57	0.85
Female	0.38	0.26	2.09	1	0.15	1.46
Pre Science Interest	0.50	0.30	2.73	1	0.10	1.65

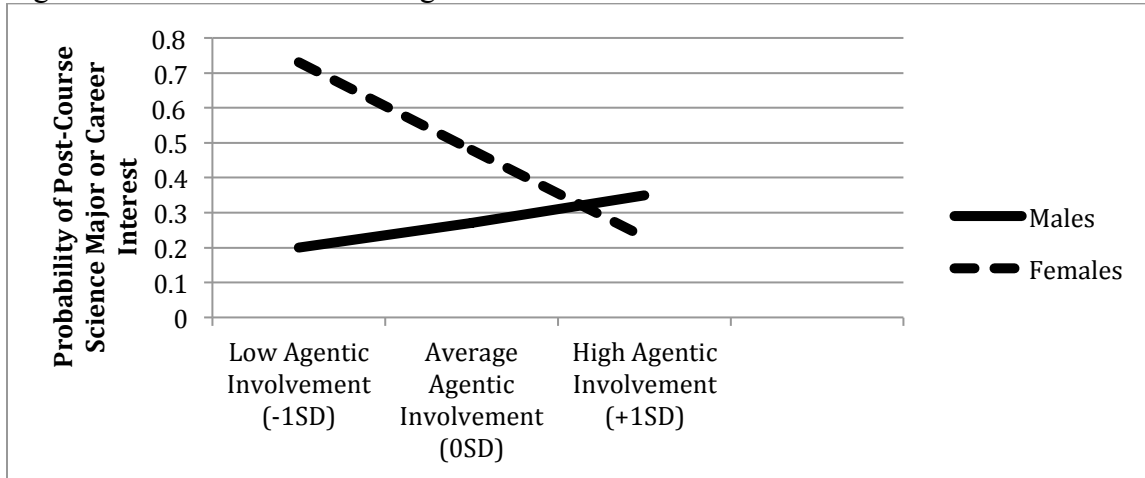
Table 5. Block 2 Logistic Regression Model Including Agentic Interaction Variables

<i>Coefficients</i>	<i>B</i>	<i>SE</i>	<i>Wald</i>	<i>df</i>	<i>p</i>	<i>OR</i>
Z Agentic Involvement	-0.36	0.53	0.45	1	0.50	0.70
Z College Confidence	0.48	0.32	2.21	1	0.14	1.61
Underrepresented Minority Status	-0.12	0.31	0.15	1	0.70	0.89
Female	0.44	0.30	2.17	1	0.14	1.56
Pre Science Interest	0.74	0.37	3.98	1	0.05	2.10
ZAgInvXZconf	0.15	0.34	0.19	1	0.66	1.16
ZAgInvXURM	0.48	0.37	1.75	1	0.19	1.62
ZAgInvXFem	-0.73	0.35	4.49	1	0.03	0.48
ZAgInvXPreSciInterest	-0.52	0.51	1.01	1	0.32	0.60

In the full model with all predictors entered, the intercept was shown to be not significantly different from zero (i.e., not significantly different from 50%; recall the values are in log-odds units) (see Table 5). Although agentic involvement and college confidence were not uniquely predictive of student's future science interest ( $p > 0.05$ ), there was a significant effect of initial interest in a science major or career. Specifically, students who were interested in science major/career at the beginning of the year were 1.48 logits higher than those who were not (double the coefficient due to effect coding) in the likelihood of their interest in a future science major/career, all else held constant. (In predicted probabilities, this translates to 55% predicted likelihood of future science interest for those who were already interested in the fall, compared to a 22% future interest for those who were not interested in the fall; the mean likelihood of future interest across all students in the sample was predicted at 37%.) This finding was not surprising, and confirmed that students who entered the class interested in a science career or college major were not deterred from this path during their time in the PBL APES class. More interestingly, there was a significant interaction between agentic involvement and gender that was predictive of interest in a science career or major. To understand the nature of the interaction, I computed predicted probabilities for females and males for three levels of agentic involvement (low = -1 *SD*, high = +1 *SD*) and plotted these values in Figure 2. As can be seen, the likelihood of interest in a future science major or career for boys and girls was moderated by perceptions of their agency in the classroom. Specifically, for students reporting low agentic involvement, females had a 73% predicted probability of future science major/career interest whereas males only had a 20% predicted probability, all else held constant. Comparatively, for students reporting relatively high agentic involvement, females had a 23% predicted probability and males had a 35% predicted

probability of future interest.

Figure 2. Interaction Between Agentic Involvement and Gender



This complicates the data that demonstrate more college degrees in STEM fields are awarded to males, suggesting that something related to perceptions of agency may happen before or during college to steer males and females into different majors and career paths. Possibly contributing to these results is the fact that this was an environmental science class. Women have a history of strong interest in environmental issues (Blocker & Eckberg, 1989; Wuyep, Dung, Buhari, Madaki, & Bitrus, 2014; Zelezny, Chua, & Aldrich, 2000), and eco-feminism (Warren, 1987). Most importantly, when boys' perceptions of agency in the classroom increased, their interest in science increased. This is important because it demonstrates a clear connection between the role of agency and content-area interest for males, which could be further explored in future studies, especially when considering males who are at risk for disengaging from school (Saenz & Ponjuan, 2009; NEA, 2011).

Gurian & Stevens (2005) argue that agentic opportunities in the classroom are essential for boys. While girls are may also be energized by strategies to support boys' engagement, they are not known to be as disadvantaged when these strategies are not

immediately present (King & Gurian, 2006). Especially at risk for disengagement are boys of color (NEA, 2011). In this study context, there was a high percentage of underrepresented minority males in the PBL APES classes, primarily in the schools that were the most poverty-impacted.

The positive effects of teaching practices that support agentic involvement for male students of color have been well-documented (e.g. Gay, 2010; Nasir & Hand, 2008; Harvard University, 2015). The PBL APES curriculum was designed to incorporate many of these strategies to support agency within the classroom, and also to empower students to make meaningful environmental changes both in the home and larger community. These results confirmed the literature that emphasizes the role of agency in the education of boys. However, the enactment of the curriculum and social context of each classroom likely contributed to the ways in which these opportunities for agentic involvement were perceived by the students. As detailed in a Harvard University report (2015), sometimes the intentions for supporting agency are not enacted as such. For example, the process of clarification is sometimes enacted as giving students the answers, which curtails students' agency in the learning process. This has both practical and theoretical implications for what it means to teach for agency.

## **Conclusion**

The analysis determined that neither students' perceptions of agency in the PBL APES classroom nor their confidence that they would be successful in college uniquely predicted their future interest in a science career or major. Nevertheless, there was a significant interaction between gender and students' perceived agency that suggested that increased perceptions of agency in boys were predictive of an interest in pursuing a science-related career or college major, but the same was not true of girls.

## Chapter 6: Qualitative Analysis and Findings

### Qualitative Analysis

Qualitative research methods (Merriam, 2009) addressed both research questions (How do students develop AP and Science identities in a project-based AP Environmental Science (PBL APES) course? How are the aspects of identity development experienced in the PBL APES class related to students' possible futures in AP and Science?). The first question aimed to understand how students' identities developed in the practices of the PBL APES learning context. The second research question explored the relationship between identity negotiation in the PBL APES context and students' identity trajectories.

In keeping with the key characteristics of basic qualitative studies (Merriam, 2009), I sought to understand how students negotiated the cultural norms and traditions of AP and Science to inform their participation in these contexts, the meanings students' made through their participation, and the ways in which those meanings contributed to their identities. Therefore, this was an appropriate methodological approach to addressing the research questions.

**Data Organization and Analysis.** I began the coding process for the qualitative data using Atlas.TI software. To look for themes across the data, I used both open codes and theoretically driven codes (Merriam, 2009) on all of the video, interview, survey, and curriculum data (see Appendix E for a complete code list). Examples of thematic codes that emerged from the data were *AP: College Credit* and *Interest: Science*. Examples of theoretically driven codes that I was seeking to apply to the data included *AP World*, *PLI: Access to the Domain*, and *CJ: Performance*. I coded the data chronologically, beginning with student interview and survey data. I coded students' initial fall term interviews prior to coding the spring term interviews, looking at both interviews from one student at a time. In other words, I coded each student's fall

and spring interviews and surveys before moving on to the next student. I then coded the video data, beginning with the Course Introduction and Eco-Footprint cycle, then moving chronologically through the subsequent cycles. I coded all of the video from a particular school classroom before coding the video data from the next school classroom. When coding the videos and interviews, I coded per speaker turn. I coded the curriculum by lesson step. I coded the survey data by item response, only looking at responses to relevant questions such as “Why are you taking this class?”

Once I had combed through the data and reached an initial point of coding saturation, I wrote analytic memos (Strauss & Corbin, 1990) to summarize the stories of each of the three focal classrooms across the year. Following the classroom-level summaries, I wrote memos that narrated the identity trajectories that each of the focal students followed throughout the curriculum. As I wrote these memos, I was mindful to note if new themes emerged and returned to coding the data accordingly. Once the iterative process of coding and memo writing was exhausted, I looked across memos at the individual and classroom level, and at the coded curriculum to generate findings that spoke to my research questions.

### **Qualitative Findings**

The qualitative data analysis sought to understand the kinds of identities that students developed in the PBL APES class, and the aspects of identity that informed their identity trajectories. This directly addressed both research questions (What kinds of AP and Science identities do students develop in a project-based AP Environmental Science (PBL APES) course? How are the aspects of identity development experienced in the PBL APES class related to students’ possible futures in AP and Science?)

**Engineered identity opportunities.** My analysis of the data suggested that the opportunities designed in the curriculum for students to access AP and Science worlds, and to be publicly recognized for their competence with the knowledge and practices associated with each of these worlds, were largely enacted as intended. In turn, students positioned themselves and each other as increasingly connected to both the AP and Science worlds.

*Eco-Footprint.* In this initial project cycle (Figure 4), students addressed the cycle driving question: How can my family live more sustainably? To do this, the Eco-Footprint project tasked students with collecting data about their own consumption patterns. Students conducted detailed water, transportation, and waste audits, then analyzed their resource use. Through this work, they learned to think in terms of systems and the Three Lenses of sustainability<sup>7</sup>. For some, connecting the work of the project with the home eased accessibility of the content and facilitated students' connections to the related practices. Iris explained that this helped her understand the material and that it was different from other classes she had taken in the past, "This class challenges me to look at myself, what I'm doing based on everyone else. Most of my classes, we would just look at, 'this is data and this is what we're going to look at and what we're going to study.' I wouldn't look at data that would come from me and that I could relate to because it was mine" (11-04-14). She continued, "I felt like all the stuff we've been doing so far I've been able to relate to usually because it affected me" (11-04-14). Different from prior experiences in school, the kind of work that was involved in the consumption audits was intended to create a hybrid space (Barton, Tan, & Rivet, 2008) in which students could build connections to the Science world.

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<sup>7</sup> The "Three Lenses" framework was an analytical tool from the discipline of environmental science. Students and teachers used it to understand the tensions among economic, environmental, and social/cultural sustainability and the relationship of these aspects to the types of problems addressed by environmental scientists.

Following their consumption audits, the students were responsible for using the Three Lenses framework that evaluates the economic, environmental, and social-cultural implications of their behaviors to find more sustainable alternatives to their families' current lifestyles. Once they researched and identified more sustainable lifestyle options, students drafted proposals for change in the home, and presented them to their families. They used their families' individual needs and interests to decide how to leverage the Three Lenses to best convince their family members to change their practices. For example, if a family had a limited income, the student could emphasize the economic advantages of reducing consumption.

Figure 3. Eco-Footprint Project Poster



In doing this work, students were offered the opportunity to be in knowledgeable roles from which they could make unique and valuable contributions to their families and the environment. Performing competence with the environmental science practices that informed these proposals had the potential to thicken students' Science identities (Nasir & Hand, 2008; Carlone & Johnson, 2007). For Logan, this involved joining together his transportation audit and

new science knowledge to contribute to his family’s decision-making process when purchasing a new family hybrid car, “After doing all this research I had a lot of knowledge on hand to decide what kind of car we should purchase with the money that we have. I believe 2 or 3 days ago, we bought a 2008 Ford Escape Hybrid” (11-04-14). This kind of recognition by Logan’s family for his developing expertise with science had the potential to thicken his Science identity.

Along with Science, the Eco-Footprint cycle was an opportunity to connect with AP, including expectations for workload and rigor. Brandon described the adjustment he made in his practices to accommodate the workload in Eco-Footprint, “I had to get the flow of how harder things were going to work in this class” (05-14-15). From the outset, the level of challenge and amount of work in PBL APES informed students understanding of what it meant to be in an AP class, and what would be involved in navigating this class differently from a regular class.

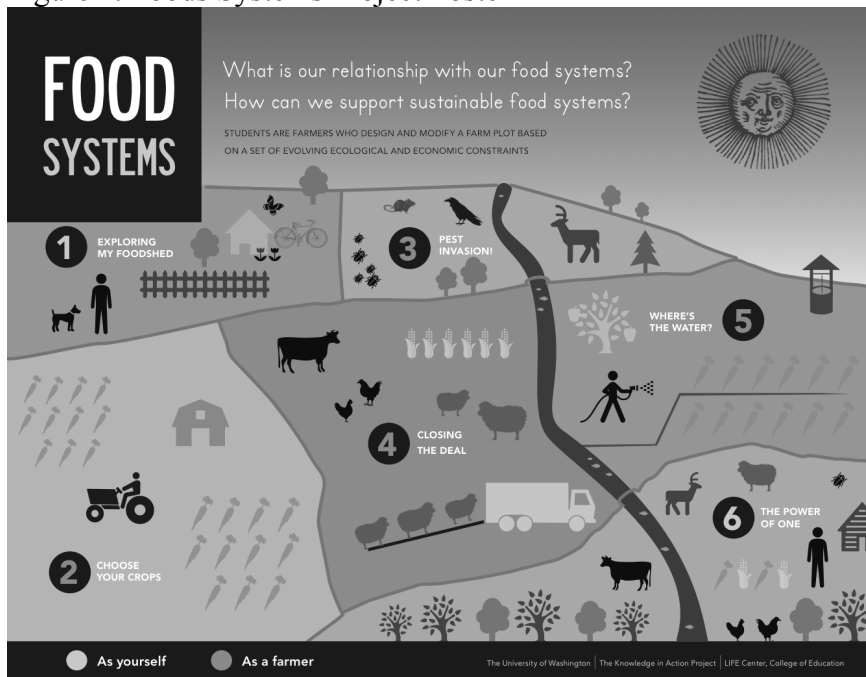
The initial tasks in Eco-Footprint were designed to give students access to the domains of both AP and Environmental Science by assigning college-level tasks to develop awareness of a real-world environmental problem. Not only did they learn about the skills and practices of AP Environmental Science, they were expected to have integral roles in doing this work, becoming competent with the relevant skills, and accountable for applying them in the learning context. In addition, they also had opportunities to perform and be recognized for their competence with these practices outside of the classroom in their homes while collecting and analyzing their data.

Access to the domains of AP and Environmental Science continued to be supported in subsequent tasks of Eco-Footprint through the students’ research and evidence-based argumentation for sustainable practices. The expectation was maintained that students would become increasingly competent with AP Environmental Science skills, which would be evidenced in their proposals. In the proposal and presentation, the students could both be

positioned, and position themselves (Wortham, 2004a), as domain experts, which would provide an opportunity for them to be recognized for performing their competence with the practices of AP Environmental Science. In the home, each student had the opportunity to make a unique and valuable contribution to the family, which potentially could serve to thicken their AP and Environmental Science identities.

***Food Systems.*** The Food Systems cycle (Figure 5) was students' first opportunity to transfer their knowledge and skills gained through addressing local real-world problems to a full simulation project. In Food Systems, students took on the role of farmers tasked with designing a sustainable farm. As students made design moves, they were given a series of evolving economic, environmental, and social challenges that required adjustments to their designs. They used topographical maps to design their farms, which helped maintain accountability to the natural world. The project culminated with the design of a sustainable farm that met all of the complex and integrated constraints presented during the project cycle. Students learned AP Environmental Science content including biogeochemical cycles, agriculture science, and water quality while using college-level scientific practices that included modeling and design. They also continued to build their skills associated with challenging reading and research anchored in environmental systems and the Three Lenses of sustainability.

Figure 4. Foods Systems Project Poster



Being in an urban school district, most of the students had very little prior knowledge or experience with farming. The meanings they ascribed to farming practices were loose associations informed by what little exposure they had prior to the course. The following episode from Howard High School illustrates the low level of identification with farming that students brought into the course (04-10-15):

Malik: I don't know what an acre is.

Ms. LaDuke: An acre is like the size of our whole school campus.

Malik: All I know is that when I drive on the highway, I see a bunch of land.

DeShawn: I be so mad because I see a house here and then a whole bunch of land! And there be like a billion miles of land! Who the hell owns all that?

Ms. LaDuke: That's what you have [in this project]. You have a huge farm.

Although Ms. LaDuke underestimated the size of the school campus, she seemed to be trying to make the content relatable for these students who were making new meanings for the concepts covered in the Food Systems cycle by connecting the unit, acre, with something that they were familiar with. Beginning with a topographical farm map of 500 acres, students were tasked with designing sustainable farms that included both agriculture and livestock. As they designed their map models, carrying forward the meanings they made during Eco-footprint related to sustainable choices, they began to understand and connect with farming practices such as crop selection, irrigation, and pest management. In this example from Ms. LaDuke's class, Farrah and her partner use a small group discussion to inform their design decisions for livestock (04-10-15):

Ms. LaDuke: Are you doing chickens?

DeShawn: Yeah.

Ms. LaDuke: Are you doing just meat or just eggs? Chickens lay eggs and you can eat them. Are you going to sell them for meat, eggs, or meat and eggs.

Farrah: Eggs.

DeShawn: We're gonna do both.

Ms. LaDuke: Do you agree with that [Farrah]?

Iris: 'Cuz if you sell them for meat you have to do that sad thing in the movie.

DeShawn: Oh no! I heard what she just said. That was messed up! *Eggs* (writes eggs boldly on map)!

Ms. LaDuke: Alright, eggs. That also can be year-round which is good.

During this episode, Farrah and her partner, DeShawn, had the opportunity to perform their competence with their farm design. It is not clear that either Farrah or DeShawn had much justification for their initial responses. However, when Iris reminded the pair of the movie that the class watched involving some questionable practices involving factory farming of chickens, the meaning of raising chickens for meat abruptly changed for DeShawn, and he definitively chose to use the chickens for eggs. Even though this was a simulation, DeShawn seemed to have connected enough to the farming practices to make decisions informed by his identity in the role as a farmer. Although he was not *really* raising chickens at all, he did not seem to want to raise his imaginary chickens to be treated as they were in the movie.

Throughout Food Systems, the curriculum was written for students to keep in mind that their farms did not exist in isolation. Acting as farmers, they had to use systems thinking to consider the impact of their choices on neighboring farms. What may have initially been considered an economic advantage to using pesticides could become problematic as wind and water could contaminate a neighboring organic farm. To support students learning the science practice of systems thinking, the Food Systems cycle included periodic neighbor negotiations during which students considered the implications of their design choices on other farms. The following example illustrates a neighbor negotiation task in Ms. Murie's Class. Brandon and Ramon and their partners shared a property line, and met to discuss their pest management systems (03-27-15):

Brandon: We use buffer zones and pesticides. We are more of a chemical farm. We use more chemicals than anything else.

...

Ramon: We have to send it to an oil company, so we use GMOs.

Brandon: We have to use regular corn. We just have to spray.

Ramon: Will that affect us?

Brandon: It shouldn't. No.

Selena: It's a yes or no question.

Brandon: No, it won't affect you.

Ramon: Ours will [affect you]. You're gonna need to build a fortress like Minecraft!

During this interaction, Ramon learned that GMOs, which meant mass production and a positive association for him and his farm, held a negative meaning for Brandon's farm that had different needs and constraints. His choice to use GMOs to meet the client demand could negatively impact Brandon's farm if his GMO corn were to contaminate Brandon's crops. Potentially, the practice of using GMOs could take on new meaning for Ramon, depending on how Brandon and his partner, Irma, would respond to the threat of GMOs next door. The use of pesticides was an acceptable practice for Brandon, but he needed to confirm that it would not negatively affect Ramon's farm to keep that meaning. Here, the curriculum was designed to create space for students to develop these meanings through interactions, which also offered them opportunities to perform their competence and hold each other accountable with newly developing practices.

Through the simulation, as students became increasingly knowledgeable about sustainable farming practices and systems thinking, they deepened their connections with these practices. Logan described, "Learning about different patterns and types of farming and stuff; that was all really interesting because it actually pertained to my specific interests, as a farmer [in

the simulation]” (05-14-14). For some these connections translated to their lives beyond the classroom. Iris started a successful garden, drawing on many of the practices she developed during this project. She described, “I started learning more stuff about it, actually like what's going on underground. I just got more interested in it, so I started the garden this year” (05-14-15). Marta described how her new knowledge contributed to her understanding of local farming practices. She shared an interaction with her mom when they were shopping, “Let’s go to the farmer’s market! We look at who's at the farmer's market, and I'm like, ‘These guys, look at what they do. That's good. That doesn't add to the eutrophication” (05-14-15). Iris and Marta’s new understandings supported their interest and relationship with practices from the Food Systems cycle.

Throughout Food Systems, as in the other cycles, there were explicit opportunities written into the curriculum to connect the work with the AP test. Making these connections visible to the students gave them an additional purpose for learning the content. For example, when the curriculum presented a drought scenario to the students, Ms. LaDuke explained, “On the AP test, when they ask how you handle a drought as a farmer, you are ready to go” (05-14-15). Making these connections visible was potentially a way for students to understand the ways in which they were developing fluency with both Environmental Science and AP practices simultaneously.

***Oceans In Action.*** The Oceans In Action project (Figure 6) was another simulation-based project. The students took on roles of town council members of a small Pacific Northwest island community. The students needed to decide whether or not to accept either of two business proposals in an effort to lift their sinking economy. In this project cycle, students again expanded their sphere of influence to the health of the ocean as they addressed their local community’s

problems. Student roles consisted of various stakeholders, which could offer the opportunity to understand multiple perspectives on real-world issues.

Figure 5. Oceans In Action Project Poster



In ally groups, students worked to prepare a series of position statements that used evidence and the three lenses framework to argue in support of, against, or to modify each business proposal. To ensure that students would argue for what each role would consider the common good of the town, one of the first tasks was for students to develop a mission statement together. Through this exercise, students developed shared values, which would inform the meanings they made of the practices they would learn about. Farrah read the mission statement created by Ms. LaDuke’s class, “We the people of Funaway Island vow to improve the economic, environmental, and social standing of our town by encouraging the development of new businesses and protecting that which makes us a whole and healthy community” (05-15-15). These students had incorporated much of the learning from previous project cycles into this statement, reflecting their values. As seen here, the Three Lens framework of sustainability had

become part of the shared repertoire of the Science world, with which the students had become increasingly comfortable using and applying in different project contexts. The economic, environmental, and social aspects of their community had become salient points of interest to target as important to the well-being of the community.

As part of their work, students needed to not only develop arguments to support their groups' positions, but also consider possible counterarguments from other groups. This also supported students in their understanding of multiple perspectives and the complex meanings ascribed to practices involved in aquaculture and oil drilling. In the following episode from Ms. Carson's class, Erin worked with a small group of students drafting arguments to take to the town council. They were trying to come up with a strong counterargument for the oil drilling company's proposition that their business will create jobs, boosting the economy.

Amy: (Stating aloud as she writes what another student in the group said) It increases jobs, but is super dangerous

Erin: We actually have the number, creates 200 constant jobs and 300 for construction.

Amy: However, it is very dangerous. Why?

Erin: Hold on, hold on...(Looks at phone and reads) because they deal with highly combustible materials on an isolated platform where there is heavy machinery swinging all of the time. The heavy machinery isn't under much control if that makes sense.

Larisa: It sounds scary, you're in the middle of the ocean.

Erin: It has statistics on how many people were killed!

Amy: What is it?

Erin: In 2008, 128 people were killed.

Amy: In what?

Erin: In the oil and gas industry. That is from Time magazine.

The students in this episode first recognized the compelling argument that 200-300 jobs would be a significant impact on their simulated community's dismal unemployment rate. To counter this, they recognized that they needed to find an equally compelling argument against those jobs. Working in ally groups to develop these points and counterpoints was an opportunity for students to perform their competence with argument development with each other, and hold each other accountable to the expected practices. Being recognized first by ally group members, and then by the larger community for fluency with these practices was intended to be an opportunity for students to be positioned as increasingly knowledgeable throughout the project. The project was designed with the intention that, by the time the town council simulation was enacted, students would be invested in their research, and connected to the practice of argument development, often times from a perspective that differed from their own.

Although there was no direct impact on the environment from their decisions in this project, given that it was a simulation, the curriculum was designed for students to have agency to make decisions in the simulation that would impact their character role and simulation community. To reap the most benefit, both personally and for the town, students needed to be competent with the skill of scientific argumentation (Ford, 2008), a skill that can be applied to other disciplines (Demirbag & Gunel, 2014). Developing evidence-based arguments, while considering and critiquing counterarguments, offered students continual access to the domains of AP and Environmental Science.

The character roles that students took on offered an opportunity for students to understand viewpoints that may have differed from their own personal opinions. From the perspective of these character roles, they were offered *integral* roles in that they were responsible for developing strong arguments to support their positions on the two business proposals. Students held each other accountable to these practices as they argued for their own positions, which established the expectation of competency with the practices of AP and Environmental Science. In other words, if a student or group's argument was not built with strong evidence to support that position, an opposing group could easily deconstruct the argument and present a stronger one for the counter position. Working in their ally groups to develop their arguments, students had continual opportunities for self-expression, and for students to offer unique contributions to the group's arguments.

**Summary.** In this section, I captured the kinds of opportunities that were afforded by the PBL APES curriculum for students to form connections with AP and Science. To some extent, students recognized these opportunities and became increasingly connected to these practices throughout the year. However, there were aspects of identity that were important mediators of these connections. One such mediator was students' histories-in-person. In the next section, I will share examples of the ways in which students histories-in-person emerged during practices in the PBL APES classroom to inform the meanings students made of these practices and their connections with the AP and Science worlds.

**The Contributions of Histories-In-Person.** While the PBL APES course offered opportunities throughout the year for students to develop connections to AP and Science practices, the curriculum alone was not the sole mechanism of students' identification with AP and Science. Students in this study entered the PBL APES classroom, they had both years of

experience in school, learning the practices associated with being students in institutional classrooms, and prescribed social positions informed by cultural historical productions. In this section, I argue that to understand the ways in which these students formed their AP and Science identities, I had to consider the social, cultural, and historical contributions of their histories-in-persons. Since, “individuals and groups are always (re)forming themselves as persons and collectives through cultural materials created in the immediate and the more distant past” (Holland et al., 2003, p. 18), the cultural legacies carried into the classroom by each student informed their ideas about the AP and Science worlds, and their roles within them. In this section, I share examples with the aim of characterizing the ways in which histories-in-person contributed to the ways in which students developed AP and Science identities.

***What it means to live sustainably.*** Near the beginning of the year, students were asked to “line up along a continuum of how sustainably they *think* their family lives right now based on the homework they did from the Footprint prep” (PBL APES curriculum, Eco-Footprint Task 0 Lesson 1 Project Launch), an activity that asked students to think about their family’s consumption patterns. The students reflected on the daily choices they and their family members made about consumption and waste to inform their placement on this continuum. Echoing ethnographic examples presented by Holland and Lave (2009), these students brought their histories-in-person to the activity that had informed their ideas about what sustainability meant, and their role in maintaining the environment. Many of the students in this study had some awareness of environmental problems, but had not developed a deep understanding of the relationship between their daily practices and the world around them.

After the lineup activity, the Eco-Footprint project cycle then asked students to conduct consumption and waste audits and analyses. In doing so, the students developed an awareness of their roles in sustaining the environment. Through this work, most students came to consider themselves to be over-consumers. After learning about the Tragedy of the Commons (Hardin, 1968) as a way to describe the human tendency to deplete resources without adequate regulation and planning for the future, the students ascribed new “meanings and emotional evaluations for such things such as flushing the toilet, buying objects with lots of packaging, and otherwise acting without regard for the Earth” (Holland & Lave, 2009, p. 6). As such, the meanings associated with these practices became part of the students’ histories-in-person, and informed their identity trajectories.

In her interview near the end of the year, Farrah described the small daily practices that she and her family engaged in that took on new meaning after learning about their impact on the environment:

Almost all the lights are always on, and everybody's always typing on some type of device. The TV, everything's always plugged in. So it's like, well, we do use a lot. Then shower time, especially during the summer, everybody showers forever. They take really long showers, and they shower like three times a day. It's like, woah! That's a lot of water, too (05-13-15).

Logan also shared some of the meanings he associated with his family’s consumption practices, “You almost feel guilty because you know this stuff and you know in the back of your mind, you should be doing *this*” (11-04-14). Being confronted by new meanings associated with waste and consumption was a disruption in most students’ histories-in-person, discordant with most students’ prior meanings ascribed to the same practices. Ramon described, “I just threw anything

everywhere. Trash, my candies, and I used to - I didn't care. But now I see what it does to Earth and I don't want to live - in twenty years, I don't want to live in an Earth full of trash” (05-14-15). All seven of the focal students in this study shared similar experiences in Eco-Footprint during which their histories-in-person surfaced during contentious social practices, which were catalysts for the formation of new meanings ascribed to local practices and students’ connections with them. Across all of the schools and years of data collection, students mentioned frequently in their interviews the impact of the Eco-Footprint cycle on changing their daily practices.

*The meaning of AP and of being an “AP student.”* As described thus far in this paper, the AP world has undergone a great deal of change. Movements such as “AP for all” have informed new ideas about what it means to be an AP student, who belongs in AP classes, and what is the purpose of taking those classes. Historically, AP classes had been reserved for an elite group of students who were considered smarter than the general education students (Rothschild, 1999; Lacy, 2010). The students who traditionally enrolled in AP classes, specifically AP STEM classes, were primarily White and East Asian middle and upper-middle class males. Students who came into the PBL APES class during the shift toward opening access to AP classes had the opportunity to reconstruct the AP world and their roles in relation to it.

The meanings that AP held for students coming into the PBL APES class varied significantly. This seemed to be in part a function of their histories-in-person brought to view when embodied during engagement in classroom practices, or when reflecting on experiences in the PBL APES class during interview segments. Keeping in mind that, “participants are historically related, partially united, partially divided, and surely always in conflict and tension through different political stances and relations of power” (Holland & Lave, 2009), the AP world was rife with contentious local practices through which students formed their AP identities.

Students in the PBL APES class had different ideas about the meaning of AP that were informed by the legacies of AP both in their schools and through history. As they participated in local practice, cultural forces contributed to the students' AP identity trajectories. Concurrent meanings culturally associated with AP included stress, challenge, status, economics, and earning college credits. These shaped the kinds of experiences that students were seeking from, and experiencing in, the PBL APES class.

*AP as opportunity.* Some students who were new to the AP world understood AP as an opportunity to challenge one's self in an academic environment, and to offer the possibility of previewing college, even maybe earning college credits and saving money in the long run. Students in poverty historically have been held to lower achievement standards than more affluent students because they are believed to be unmotivated and value education less than their wealthier counterparts (Darling-Hammond, 2010; Gorski, 2008). The assumption that poor students are less capable than wealthier students has largely affected students of color (Darling-Hammond, 2010; ). Layered on to the assumptions about impoverished students of color is another cultural assumption about college providing a means to lift people out of poverty (ETS, 2013). Given that, "the manifestations of child poverty influence both the educational opportunities available to children and the educational outcomes that they will likely achieve," (ETS, 2013, p. 4), policies that open access to educational opportunities can also open access to more economic resources. An "AP for All" approach presents economic hope to students in poverty who have been traditionally shut out of similar educational opportunities, and provides opportunities for rich challenging learning experiences that they may not have in their general education classes.

Both Ramon and Farrah were new to AP and had very little contact with AP prior to the PBL APES class. The two students attended different schools in the district that had recently added AP classes to their course catalogues, and that had high percentages of students of color and students on free or reduced lunch. Ramon's and Farrah's parents were born in another country and primarily spoke a language other than English in the home. Their mothers' highest level of education completed was elementary school, and neither student knew many people who had attended college. In our current economic context that emphasizes formal education from Pre-K through college, education is well-known as a, "great equalizer, able to mitigate the effects of poverty on children by equipping them with the knowledge and skills they need to lead successful and productive lives" (ETS, 2013). Both of these students have plans to attend college and were excited for the opportunity to sample what college might be like via the AP program.

Both Ramon and Farrah shared their desire to challenge themselves with the PBL APES class. Remembering registration for the class Farrah said, "Well, they said, 'Advanced Placement.' I thought of it as challenging and stuff, it's not my level, it's higher than my level, so let me try it" (11-06-14). Having no existing first-hand connections with AP, she thought that the class would be, perhaps, too difficult. Welcoming the challenge, she signed up. Similarly, Ramon shared that he had no guidance in selecting this class from friends or counselors. Most of his friends did not do well in school, "They don't like going to class and stuff like that" (11-05-14). Different from his friends, who shared a fairly common experience among male students of color, struggling with traditional norms of academic success (Saenz & Ponjuan, 2009), he enrolled in PBL APES because, "I like to challenge myself, to see what potential I have" (11-05-14). These two students also understood AP as a way to preview college. The College Board advertises that, "AP brings the college experience to your high school" (College Board, 2018).

Adding to her explanation of why she took the PBL APES class, Farrah said, “I took AP to see how it actually would be in college and it’s not bad” (11-06-14). Ramon also was using AP as a window into college. He shared, “I wanted to see if I'd do good or not in college and I wanted to get college credit” (05-14-15). Ramon was using the PBL APES class as a way to test his readiness for college. Given the two students’ limited social resources for understanding college, the AP program was presented as, perhaps, the best way to learn about the meaning of college readiness.

Also in his statement, Ramon revealed the cultural narrative about AP classes providing a way to earn early college credits or prior to graduating from high school (Hallett & Venegas, 2011). If students passed their AP tests, some colleges would grant credit for those classes (College Board, 2018). For students who were concerned about the cost of attending college, this was presented as a way for them to save money (College Board, 2018; Hallett & Venegas, 2011). Ramon shared this belief about the role of AP classes in higher education. He said, “I'm planning to go to college and it's better right now to take advanced courses so in the future, when I go to college, I don't have to pay as much for more courses” (11-05-14). Ramon’s social cultural and historical context had informed his ideas about the value of attending college, and also an understanding about the monetary expense of that plan.

When these students were asked to reflect on who should take AP classes, they both conceived of an AP world of opportunity, open to all students who were interested in belonging. When discussing the kind of people who should take AP classes, Farrah described (05-13-15):

People that are ready. People that are looking for, people that know what they want. Like, I'm not saying you have to know specifically what you want, but if you don't want to waste your time basically. If you want to do something you know that will help you

either way, then yeah. Even if you don't get the college credit, it will help you or prepare you for college.

She connected Advanced Placement with people who were driven by challenge and college-bound. She did not associate Advanced Placement with intelligence or use it as a way to define smartness.

Ramon had similar ideas about who belonged in the AP world. He shared, “People that want a challenge, see something new. If they're going to college, to see if they'll be ready or not. This helps you get ready for college.” Like Farrah, he associated AP with challenge and college preparation. Having described himself as, “A person who doesn't give up easily,” he connected strongly with his ideas about AP. Entering the PBL APES class with this kind of history-in-person shaped Ramon’s and Farrah’s experiences in the class, their connections with the AP world, and their AP identities.

*Stress and status in AP.* A number of students had considerable opportunities for learning about the AP world throughout their school careers. For some, the AP world held connotations about status and stress. Erin and Brandon came from fairly privileged backgrounds and enrolled in the PBL APES class because it had been suggested to them by other students or adults. Erin attended Richland High School, the school that had a history of sending about two thirds of it’s students to off-site AP classes, and that enrolled the fewest number of students on free and reduced lunch. She was enrolled in the PBL APES class at Richland, and then two other AP classes at the off-site AP school where the AP program had historically been held. Brandon attended Eaton High School, which was among the most diverse and poverty impacted of the schools. However, Brandon’s father was an accountant for the school district, and Brandon’s family lived comfortably. Both students were White and their parents had college degrees.

What seemed to be most important about AP classes for these students was the label of “AP.” Erin described AP as a way to elevate one’s high school transcript when applying for college. Erin said, “It looks good on your transcript if you’re taking APES and AP classes” (11-06-14). Brandon considered AP classes as a kind of academic status symbol, saying, “Advanced Placement, so you're higher up. You should be well-respected for taking those classes” (11-05-14). He also suggested that the badge of AP was a title for the *students*, rather than the class content, “for the most part AP is just a title for yourself. It almost gives you a confidence boost in a way” (05-14-15).

One aspect of the AP world that Erin and Brandon shared was a culture of stress. Throughout her interviews, Erin reiterated that she equated AP with stress, “I think of it as advanced and stress” (11-06-14). Brandon also described his AP classes as really “stress-heavy” (11-05-14). Similar to the way in which the students in the PBL APES class made new meanings for their daily practices as described previously, the PBL APES class offered an experience that conflicted with their meaning of AP as stressful, creating an opportunity to reimagine what could constitute an AP class. Erin described how PBL APES was different from her other AP classes (11-06-14):

I don't feel as pressured to learn things, as pressured to complete, I don't know how to put this, in some of the other AP classes when I'm given a really long assignment I feel like I'm pressured and I'm not really learning anything, I'm just forced to do it. With APES I feel like I'm excited to learn things.

Brandon shared a similar sentiment when comparing PBL APES with other AP classes. He explained that PBL APES was, “a lot less weighted, I feel like, not as much pressure and projects aren't as difficult for me to get done. That's what I enjoy about it. A lot of my other ones are

really stress-heavy. This one's not as stressed as much, to me anyway” (11-05-14). When asked what he attributed the alleviation of stress to, he specifically noted the project-based course design, saying, “project-based stuff is easier to handle, being more creative and whatnot” (11-05-14). Erin also gave a nod to the PBL curriculum when discussing the difference in expected stress in the class, saying, “It’s very different . . . It's more about how much you put into it is how much you're going to get out of it” (11-05-14). These new meanings of AP crafted through living the project-based curriculum became part of these students histories-in-person and helped to shape their AP identity trajectories.

*Understanding multiple histories.* Different cultural narratives and purposes for the AP program came together on a daily basis in the PBL APES classroom. Some students were using AP as an opportunity to find challenge and rigor, different from what they had been offered in previous learning contexts. Others were carrying forward the notion that AP was a status symbol reserved for a select student group. These sometimes conflicting aspects of AP were the embodiment of larger historical factors shaping students’ understanding of the AP world. Disrupting the culture of stress was one way in which the PBL APES curriculum contributed to students’ evolving histories-in-person. Understanding the *kind* of histories that were in each person was important in learning how students developed connections with AP and their AP identity trajectories. Ramon and Brandon, for example, navigated these different interactions between their histories-in-person and the practices of the AP world as they understood them alongside each other in the Eaton High School classroom, each cultivating different AP identities, even as they interacted with each other in class.

*Science-in-person.* Like the AP world, the Science world has had a long history of power and privilege dynamics that shaped what students in the PBL APES class understood as

science. Ongoing debates about what counts as science have informed ideas about the meaning of science and its role in various cultural contexts. Conceptions of science are so deeply culturally embedded that teaching and learning science has been described as teaching and learning culture itself (Aikenhead, 1996; Coburn, 1994). A legacy of Western mainstream science has underscored the way in which science has been conceptualized and taught in U.S. schools for some time (e.g. Aikenhead, 1996; Cobern, 1996; Le & Matias, 2018; Meyer & Crawford, 2011). The mainstream Western conception of science, “isolates its objects of study from their vital context by putting them in simplified and controllable experimental environments – which also means that scientists separate themselves from nature, the object of their studies” (Mazzocchi, 2006, p. 464). This cultural knowledge of science could encourage a narrow understanding of science, “When I think of science, I think of lab coats” (Farrah, 11-06-14). Ramon echoed this perspective saying, “When I was small I wanted to be a scientist because it looked so cool. I had glasses and everything” (05-14-15).” This kind of Western mainstream scientist icon is a legacy from the time it was institutionalized, and has been referred to by some as White Male Science (Pomeroy, 1994). Simply conduct an internet search for images of “scientist” and these kinds of images fill the screen. Teaching only a Western science perspective of science has been challenged by numerous scholars who argue that non-Western science methods and perspectives are legitimately scientific and, possibly, more applicable to the natural world (Ogawa, 1995; Guidotti, 2007; Huntington, 2000; Polfus, Heinemeyer, & Hebblewhite, 2014). The PBL APES class provided a context for students to embody an ongoing struggle to define and connect with science in a way that was both validated by the Western science community, and also accounted for the ideas taken up by non-Western science perspectives. For example, the continual application of the social-cultural lens when developing family proposals

in Eco-Footprint, or drafting arguments for the town council in Oceans In Action, was a non-Western science aspect of the PBL APES curriculum that was integrated with Western-valued quantitative data to support those claims. These kinds of competing historical forces shaped the students' understandings of science and contributed to students' experiences in the PBL APES class.

Students' regular engagement in contentious local practices in the PBL APES context informed their Science identity trajectories. When students in the PBL APES class encountered science practices that were immediately connected to their daily lives, they started to shift their understandings of science away from the Western Scientist to a more nuanced meaning of what it meant to be *scientific*. This understanding of science as a way of thinking about the world, rather than as a collection of compartmentalized types of sciences (as a noun) (Iaccarino, 2003), was another way in which the PBL APES class disrupted students' histories-in-person and offered an opportunity for them to develop new connections with the Science world. Several students expressed that the PBL APES class challenged and changed their ideas about science. Iris explained that, "this [class] helped me delve in more to how everything in all of the systems in the entire world, they're interconnected even if they don't seem like they are" (05-14-15). Other students in the class also shared a new understanding of science as knowing, "all of the connections between everything" (Marta, 05-04-15). Farrah's history-in-person surfaced when she explained that, after taking the PBL APES class, she came to understand that, "There's more to science! Just taking a walk in the park, and just observing what's around you, that's science" (Farrah, 11-06-14).

Students who described this disruption in their cultural historical knowledge of science expressed increased interest in the discipline. Brandon said, "this kind of helped me jump back

on top and on board with the whole science topic” (05-04-15), and Logan said, “it's rekindled the flame ... This has really made me interested in stuff and reconsider positions in like agriculture and forestry and stuff like that. It gets me revved up about it, which is cool. It's what it should be doing” (Logan, 11-04-14). Connecting science with a way of approaching problems scientifically, rather than becoming a Western scientist, widened opportunities for students to develop science identities.

**Summary.** In this section, I illustrated the ways in which students' histories-in-person prescribed meanings they associated with the AP and Science worlds, contributing to the ways in which they understood their relationship to those worlds. I also described the role of the PBL APES curriculum in creating space for students to engage in contentious local practices that challenged these prescribed meanings, and supported their agency in crafting new meanings and connections with AP and science. Because students were actors in both the AP and Science worlds simultaneously, their experiences in each potentially informed their experiences in the other. As Brandon developed new understandings of an AP world in which stress was less representative of the culture of AP, he also became more interested in science. Similarly, as Farrah constructed her understanding of the AP world as a world of opportunity for challenge and growth, she also broadened her understanding of what “counted” as science.

Students' perceptions of agency also mediated students' AP and science identity trajectories. While many students shared experiences of increased agency, especially in the Eco-Footprint project cycle, the simulations seemed to complicate students' agentic involvement in the PBL APES course. In the next section I will explain different ways that simulations contributed to students' perceptions of agency and authorship of their identities.

**Perceptions of Agency.** The simulation projects were designed with the intention of offering opportunities for students to understand environmental problems from multiple authentic perspectives. The Three Lenses of Sustainability framework supported students in understanding the social, economic, and environmental tensions that different stakeholders wrestled with in addressing these problems. In both the Foods Systems and Ocean In Action projects, students were making decisions from the perspective of their project roles, not as students in the class. There was variation in the way in which students experienced these simulations that ranged from an increased sense of agency that came with understanding multiple perspectives to feeling constrained by having to embody opinions that differed from their own. In the following examples, I describe the role of experienced agency in two students' identity trajectories.

*The advantages of perspective-taking.* Logan was a self-described environmentalist who was taking the class to learn how to impact the lives of others. He stated that he enrolled in PBL APES, "to better educate myself so I can educate other people. I intended to educate myself so that I can change my habits, which I've done, or invested in certain things. See if I can impact my community" (11-04-14). By educating others, he would not only be making a valuable contribution to his community, but he would be assuming accountability for properly educating those less knowledgeable, what Nasir & Hand (2008) consider as having an integral role in meaningful activity.

For Logan, taking on roles in the simulation projects offered him the opportunity to expand his repertoire of APES practices in ways that he would not have had access to in a traditional lecture-test classroom. He explained, "There's a difference between, I could study all these things that farmers do, [compared to] having to actually apply it to my own farm ... Same

with Ocean in Action, as a marine biologist” (05-14-15). Logan explained the usefulness of learning to make decisions from perspectives that did not align with his own. He said, “Those are all social-cultural, those are political things and I can contribute that to my [own] political views and conversations with people” (05-14-15). He continued to explain a local scenario in which there were competing opinions, and how the simulations helped him better understand the different sides of the argument (05-14-15):

People are just like, “Right now our drinking water has a lot of nitrates in it, and it's from the farmers in the northern counties.” They're like, "Oh, why don't the farmers just stop?" Now I understand better why they're doing it and how hard it is to stop it and the technicalities involved. It helps me understand my community better, and also political issues, because a lot of things are not as simple as they seem.

In this description, Logan explained how role-playing supported his learning. He described how he could better understand multiple perspectives, and how he was more informed about complex geopolitical issues. Understanding people’s different needs and interests helped Logan see himself as a more informed community educator. Roles gave Logan authentic access to the domain and opportunities to develop competence with practices that otherwise may not have been available.

This increased knowledge of multiple perspectives supported Logan’s increased agency as a community educator. He shared that after his experience with role-playing, he felt compelled to action. “I can't just live with this knowledge and not do anything with it” (05-14-15). He continued by sharing his ideas about his future self, “I need to do something about a lot of stuff and I definitely want to have my life maybe possibly centered around some natural stuff, like being a farmer or a forest ranger or something like that” (05-14-15). For Logan, the simulation-

based learning “fits my views. It's just been very interesting. It's very relatable to current issues and I'm definitely into that”(05-14-15). His perceptions of agency increased through the simulation projects, and provided an identity-supportive learning context.

*Suppressed agency.* Iris was a self-proclaimed feminist and a journalist for the school paper. In her fall interview, she talked about her future plans to major in journalism, and how important it was for her to be able to express her opinion in writing. She said, “I can write about issues, like my opinion on something. I recently wrote an opinion piece on feminism. That was really easy for me, because I am a feminist and so I just spoke like what I thought” (11-04-14). She then brought attention to her aversion to writing pieces that did not allow opportunities for self-expression, stating, “Actually, delivering the news is difficult, without being able to put my opinion into it” (11-04-14). For Iris, having these kinds of opportunities to put aspects of one’s self into the practice was especially important.

Iris experienced the simulations quite differently from Logan. Rather than providing an eye-opening and enlightening opportunity for Iris, role-playing frustrated her. She explained, “In both of them I was given a role that I wasn't able to break out of that role at all”(05-14-15). She wanted to be able to voice her own opinion on the issues presented in the projects, and did not feel that the simulations offered any space for her to do so. Although perspective-taking is an essential aspect of journalism (Glück, 2016), an identity that Iris referred to frequently, she leaned heavily toward the Op-Ed style of writing through which she stated she could freely voice her own opinion.

She reflected on the challenges presented by the Foods Systems project, “Because with my farm, I was given the – my client, they wouldn't let me – I wasn't able to grow my own stuff, like I had started my project and everything, and then it would change” (05-14-15). By the time

Iris was asked to make several revisions to her farm, she expressed, “If it had been like a real-life situation, I probably would have just sold my farm” (05-14-15). Iris did not recognize the series of evolving constraints as helpful to her learning. Instead, she experienced them as discouraging. What could have been perceived as an opportunity to develop empathy, a critical resource for journalism (Glück, 2016), was eclipsed by the perception of the simulation suppressing Iris’ voice.

In the Oceans In Action project, she had another negative experience. She explained, “I wasn't able to make sense of why my person's role was even in question, like why was I part of it, because in it, I was the part-time resident, and so if I only live in this place part time, I don't understand why my opinion mattered all that much” (05-14-15). Conceiving of her role as unimportant from the beginning interfered with Iris’ perception of agency in the project. At one point, she raised her concern with her teacher (05-07-15):

Iris: Do part time residents actually live there?

LaDuke: Yes. Part time.

Iris: Then why do I have any say in this?

LaDuke: For example, my aunt and uncle live in Minnesota in the summer and Florida the rest of the year. So wherever they live the longest, that's what they make decisions about. They live in Florida most of the year, that's where they have a say about. So they would go to that city council. They don't have a lot of decision making in MN, but they could still put their opinion in.

Although Ms. LaDuke explained that even part-time residents had a legitimate voice at the town council, Iris continued to question her role's relevance in the project. She also explained her difficulty to connect with the role to which she was assigned, "I had a really hard time thinking of doing the work in the role not as myself because the person in the role might do something other than what I would have done" (05-14-15). When the project ended, Iris' perception of not only having an unimportant role, but one who's perspective differed from her own, interfered with her sense of agency in the project. This decreased sense of agency from this kind of experience in role-playing simulations was not an identity-supportive context for Iris, who did not perceive the connection between developing skills for perspective-taking and her Journalism identity. Opportunities for self-expression have been noted by Nasir & Hand (2008) as a critical aspect of a context that supports connections to practices. Having an opportunity for Iris to step out of her role and speak from her own perspective may have better supported her agency and connection with the simulation-based projects.

Not only could increased opportunities for self-expression support Iris's connection with PBL APES (as it did with Journalism), but a restricted perception of agency may have actually suppressed opportunities for Iris to identify with the AP and Science worlds. Near the end of the year, when asked if she saw any connections between this class and her future plans, she replied, "Not really" (05-14-15). When asked to reflect on content and learning from the year, Iris remembered big concepts, such as the interconnectedness of Earth's systems, but struggled to remember specifics, saying, "I can't remember" (05-14-15) throughout her spring interview. Since opportunities for self-expression were particularly important to Iris, constraints to her AP and Science identity may have felt especially restrictive by her experience with the simulations and role-playing.

**Summary.** There was considerable variation in students' perceptions of agency in the PBL APES simulation projects contributing to their connections with the related practices and identity trajectories. Although the curriculum was designed with the intention of offering opportunities for students to understand multiple perspectives and complex tensions involved in environmental problems, the enactment of these simulations did not always go as anticipated. I shared these experiences of perceived agency in the classroom as examples of an additional layer of complexity that needed to be considered when exploring students' identity trajectories through the PBL APES class.

### **Conclusion**

This chapter presented the major findings from my qualitative analysis. In seeking to understand how students developed identities in the PBL APES class, and the aspects of identity that informed their identity trajectories, I learned that the curriculum did provide spaces of opportunity for students to develop and thicken their AP and Science identities. At the same time, it also was evident that the students' experiences in the PBL APES class needed to be analyzed in a larger social cultural historical context to understand the kinds of identities and meanings with which participants entered the class, and their interaction with the PBL APES class. The third finding was that students experienced different perceptions of agency, especially during the simulation-based projects, that did not always align with the intended design of the curriculum. The following chapter will discuss the practical and theoretical implications for these findings, concluding with the limitations of this dissertation and possible future directions for study.

## **Chapter 7: Discussion**

In the early chapters of this dissertation, I presented the research problem and outlined the questions that guided this study. In addressing those questions, I aimed to understand how students in the PBL APES context socially identified with AP and Science, and the relationship of those identifications with their futures. In this final chapter of this paper, I will discuss the theoretical and practical implications of my findings. I also include suggestions for future studies and review the limitations of this study.

### **Studying Identity in the PBL APES Context**

Nasir explains that identity formation happens when participation in a practice, “is an integral part of who one is and becomes. That is, when one comes to see the definition of who one is in relation to participation in a learning setting” (Nasir, 2011, p. 129). In this dissertation, I sought to understand this process of becoming, defining one’s self in relation to AP and Science, and the role of PBL in this process.

As a curricular innovation for the AP program, PBL APES provided conditions put forth by Nasir & Hand (2008) that had the potential to support practice-linked identities connected with the AP and Science worlds. The curriculum was written for students in the class to see themselves *as* environmental scientists, farmers, and town council members, knowing that they were acting in these roles using college-level skills and practices. Not only did the PBL APES course largely offer these contextual supports, it provided a study context in which I could observe the ways in which these intended opportunities played out in the different classrooms.

PBL APES was designed to provide students with access to the domains (Nasir & Hand, 2008) of AP and environmental science by supporting their use of college-level discipline-specific skills and practices to tackle real-life environmental science problems (Gordon, 1998).

Approaching the challenges put forth by the PBL APES curriculum in collaborative groups in which students shared ideas and problem-solved together provided a window for me to understand how, and the extent to which, the domains of AP and Science were accessed. Even in the Eco-Footprint project, in which students wrote individual proposals to their families, students were expected to work together in class to learn the content that would support the proposals.

Another contextual support for identification with domain-related practices is the opportunity to have an integral role in the classroom (Nasir & Hand, 2008). Specifically, this means, “the extent to which participants are held accountable for particular tasks in a practice and are expected to become competent and even expert in a subset of activities that are essential to the practice” (Nasir & Hand, 2008, p. 148). The structure of the project-based model offered opportunities for me to study the extent to which students took opportunities to perform competence with their developing skills, and the extent that they were recognized for that competence by their peers and teachers. Students’ were either recognized for their competence or held accountable through peer and teacher critique. This process of performance and recognition of competence is noted by Carlone & Johnson (2007) as essential for forming identities. Repeated moments of recognition contribute to the thickening of those identities (Wortham, 2004a). The PBL APES context allowed me to witness this iterative cycle of performance recognition over the course of the year and across different projects, and the ways in which students were positioned as more or less competent with APES skills and knowledge.

The third dimension of an identity-supportive context is the opportunity for self-expression, “to make a unique contribution and feel valued” (Nasir & Hand, 2008). Provided that students used disciplinary skills and practices to address the problems driving the PBL APES curriculum, students had the authority to address those problems in ways that drew on their

individual strengths and knowledge. The PBL APES curriculum allowed space for students to make unique contributions, and for me to observe the process of students being recognized and valued by others in the classroom for these contributions. Eco-Footprint offered an opportunity for self-expression that was different from the other projects by supporting a crossover from school to home, creating a hybrid space (Barton, Tan, & Rivet, 2008), which is known to support students' learning and engagement. Recognition of competence in both the classroom and the home contexts had the potential to magnify students' connections to the APES practices and, in turn, the thickening of their related identities. Although I did not observe students' performance recognition in the home, students shared their experiences in their interviews and in class. Studying students' identities in the PBL APES context allowed me to better understand the ways in which moves of performance, recognition, and positioning all worked together to inform the extent to which students became connected with the AP and Science worlds.

### **Interpreting opportunities for agency**

Although the PBL APES curriculum was designed in ways that potentially could offer many opportunities for students to develop AP and Science identities, this study supported literature emphasizing that curriculum does not operate independently. It is just one piece of the learning context and must be enacted by the students and teachers in classrooms. In all classrooms, teachers and students mediate implementation of curricula in ways that may differ from the ways they are intended (Castro Superfine, A., Marshall, A., & Kelso, C., 2015). These variations informed students' understanding of AP and Science, and the ways in which they negotiated their AP and Science identities.

As was evident in this study, perceptions of agency consistently seem to play a key role in identity development (e.g. Nasir & Hand, 2008; Holland et al., 2003). My quantitative analysis

showed that boys who perceived high levels of agency in the PBL APES class were more likely to pursue a future in a content area related to science. However, there was not a general sense of high agentic involvement among the boys in this study. This points to a notion that boys may need strategically crafted opportunities for an increased sense of agency that PBL can potentially provide, (Gurian & Stevens, 2005). This may be especially important for boys of color, who might be at risk for disengagement in the AP learning context where they have been historically marginalized, and warrants future research.

An example of the discrepancy in perceived agency was exemplified by Iris, who demonstrated that assigning roles to students may not have the desired outcome that was intended. Nasir (2011) states that, “the organization of learning settings, [and] the roles youth are accorded and take up in those settings” (p. 132) are ways in which identity opportunities can be offered in a learning environment. Iris’ experience of the way in which the PBL APES learning setting was organized had the opposite effect for her. While there may have been other ways in which boys’ sense of agency was restricted, Iris’ case highlights one way in which the PBL APES curriculum was enacted that was discordant with the way in which it was conceptualized, as an opportunity for perspective-taking and developing increased agency. Iris initially felt connected to the PBL APES curriculum and was excited to explore her own data in Eco-Footprint. In the Foods Systems cycle, she maintained some connection with the environmental science world via her home gardening project, but was frustrated by the farmer role. Her experience in the Oceans In Action simulation had the largest negative impact on her identity trajectory. Iris’ identity as “an opinionated person” (11-04-14) conflicted with her interpretation of the way in which the project was organized, which not only suppressed her ideas, but also shoehorned her into a character with opposing views. Her identification with Journalism did not

seem to include space for empathy and understanding issues from multiple perspectives, which could have supported her engagement with these projects. Thus, her connection with both the AP and Environmental Science world weakened.

These findings, the role of agentic involvement in boys' trajectories and Iris' frustration with the roles in the PBL curriculum, raise the issue of the ways in which students interpret and experience intended opportunities for agency in the classroom. There is substantial literature that supports the idea of teaching for agency, especially with boys of color (e.g. Ferguson, Phillips, Rowley, & Friedlander, 2015). However, this dissertation demonstrates that is important to be careful when implementing strategies such as simulation roles, because, as we saw, this can have the opposite effect. Students tend to want to perform their roles from a personal stance (Parker & Lo, 2016), which makes sense given the role of opportunities for self-expression in identity development (Nasir & Hand, 2008). However, they most often do this when they have little expertise with the skills of a particular discipline (Parker & Lo, 2016). They rely on their experiential knowledge to inform their decisions. Students like Logan, who have established AP and environmental science practices prior to entering the classroom, experienced the role-playing simulations quite differently from the way that Iris, for whom this was her first AP science class, perceived them. This is not to say that all of the students new to AP did not successfully engage with role-playing and perspective-taking. My point is that students with less disciplinary skill and knowledge may need additional scaffolding when asked to develop arguments and justify decisions from perspectives other than their own. Given that there is increasingly greater diversity in AP classes, including in the students' levels of academic preparedness and, it may be worth exploring the ways in which well-intended opportunities for agentic involvement in classrooms are perceived. It may be that an exploration of agentic engagement, "students'

constructive contribution into the flow of the instruction they receive” (Reeve, 2013, p. 579) can be brought to the fore as a focus for research in the PBL context. Research in this area might contribute to understanding the kinds of interactions in classrooms encouraging perspective-taking that also allow space for student voice.

### **Re-membering the AP world**

This study highlights the relationship between identities and contexts, and emphasizes the agency that actors in figured worlds (Holland et al., 2003) have in creating the worlds with which they identify. Because the AP world is in the midst of a cultural shift, this study brings to view the synchronous interplay between the creation of figured worlds and identification with those worlds. These worlds, “rest upon people’s abilities to form and be formed in collectively realized ‘as if’ realms” (Holland, et al, 2003, p. 49). Similar to the questions that Holland et al. (2003) hypothetically posit when ruminating on how these worlds are created<sup>8</sup>, this study suggests that the AP world is in tension between competing questions. One question might ask: what if there were a world in which students who were considered smarter than other students could take special classes that would help them get even more ahead of regular, less smart students? Contrast this with a question that asks: what if there were a world in which high school students who were interested in going to college could experience what that might be like with classes that were designed to challenge students with college-level material? As students are recruited into these different AP worlds, they form their identities in relation to their understanding of those worlds. As students assign meanings to the actors, artifacts, language, and practices in the AP world, they come to see themselves in relation to that world. Their understanding of this

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<sup>8</sup> In the book, *Identity and Agency in Cultural Worlds* (2003), Holland and her colleagues write a number of “what if” questions that help the reader imagine how figured worlds are created (e.g. “what if gender roles were defined so that women had to worry about whether they were attractive” (p. 49)).

relationship and identification is inextricably connected to the version of the AP world that they have helped to create.

The student experiences in this study echoed the changes happening in the world of AP. The narratives of these students reflected the nation-wide policy shift to increase diversity in the AP program, and to change what it means to participate in the AP program. Currently, on the College Board website, there are pages for prospective AP students. They feature photos of students of color and females in lab settings, and list what they call, “myths and realities.” These myths and realities reflect different constructions of the AP world. Myths include, “AP courses are too stressful,” and, “Myth: AP courses are for students who always get good grades” (College Board, 2018). The corresponding Realities state, “It’s no secret that AP courses are challenging. But in collaborative classrooms and for subjects you care about, the support you receive from your classmates and teachers can help ease your worries, once you know you’re committed and willing to do the work,” and, “AP courses are for any student who is academically prepared and motivated to take on college-level” (College Board, 2018). On these pages, the College Board acknowledges the historical narratives embodied by Brandon and Erin, that were uniquely disrupted by their experiences in the PBL APES classroom. These AP histories-in-person contributed to students understanding and development of AP identities, and surfaced through students’ interactions and engagement in the PBL APES practices. As “AP for all” continues to expand as a policy movement, these histories will continue to periodically surface and create tensions in increasingly diverse learning contexts.

For students like Farrah and Ramon, for whom PBL APES was their only AP experience, these “Realities” seemed to ring true. They were using the PBL APES class as a way to preview college and fulfill a desire to experience challenging learning opportunities. Different

understandings of the AP world represent the evolving context the students in this study were navigating, including the daily convergence of those seeking status and educational capital with those seeking opportunity and challenge. Even though these students were participating in the same classroom context, the figured worlds in which they were authoring their identities were different, yet overlapping and intersecting in the PBL APES classroom.

The PBL APES context offered an opportunity for me to understand the different ways in which students constructed the AP world, and the meanings they made of the PBL APES course in relation to their understanding of the AP world. Like all figured worlds, the AP world is comprised of traditions (Holland et al., 2003) that inform the ways in which its members conceptualize it. Students new to the AP world have the opportunity to create new traditions and ways of being members of this world. As with other figured worlds, the AP world is social and position matters (Holland et al., 2003). Given the opportunities that PBL can offer to perform and be recognized for competence in this world, a wider diversity of actors in this kind of learning context may have opportunities to position themselves, and be positioned, as valuable members in the AP world. Because figured worlds are formed through social practice, the actors have the opportunity to change the AP world to make space for new kinds of membership, related practices, and understanding of what it means to identify with that world.

### **Identities across two worlds**

Studying identities in the PBL APES context also shed light on the multidimensional nature of identity. In this context students were negotiating Science and AP identities concurrently. While studies on identity in learning contexts have focused on one kind of academic identity (e.g. math identity), students in this study's context were negotiating both their Science and AP identities together. As such, they were simultaneously constructing their AP and

Science worlds, and their roles within them. Sociocultural and situative theoretical perspectives acknowledge the multiple nature of identity, and that people embody many identities that surface in various contextual moments. The PBL APES context offered an opportunity for me to observe students actively engaging in practices from both the world of AP and Science at the same time, and to follow their different trajectories through the worlds of AP and Science.

It is common knowledge that there is a cultural emphasis in the U.S. on students pursuing degrees in the sciences. Students may connect with the AP world, and become ready to enter college, but there are many contextual factors contributing to their decision of which career path to take. The quantitative analysis demonstrated that students' confidence in college did not predict their imagined futures in science. This suggests that a strong AP identity, connected with a future in college, may not be related to students' Science identity trajectory. However, the qualitative analysis complicated this finding, revealing that, while students may not be interested in becoming scientists, they did see ways that the skills and practices from the PBL APES class pertained to their intended futures. Having a science identity does not need to mean a *scientist* identity, but a *scientific* identity. I argue that this is a meaningful outcome because science practices learned in PBL APES can enrich students' lives in other ways. Even when pursuing majors outside of STEM, or even when moving through daily life, thinking in ways that are analytical, using evidence to support claims, and considering the interconnectedness of systems we encounter are considered valuable across disciplines (Waldegrave, 1994; Kuhn, 1993; ), and have useful applications in other AP classes and as college and university scholars.

Traditional STEM fields need not be the identity trajectory for everybody. The PBL APES class offered students opportunities to learn how environmental science practices can be applied in a variety of non-STEM careers. A farmer is not a STEM career, nor is a fisherman, but

students learned which environmental science practices were relevant, and used them to learn and grow into their scientific identities.

Not all of the students in this study followed a strong AP identity trajectory. All of the focal students in this study emerged from the year intent on attending college. This suggests that the students who were conceptualizing AP as a preview for college, as having value on a college application, or trying to gain credits or placement in college predicted following an AP identity trajectory into their intended futures. However, not all students saw connections between AP and their intended futures. Students who did not connect their AP experience with college, even if they planned to attend, did not seem to thicken their AP identities. This divergent experience among students with AP did not quite align with students' connections to their Science worlds. While they did not all emerge as traditional scientists, there was evidence that students in this class did thicken their identification with the Science world. This suggests that interdisciplinary majors and career paths might provide avenues for students to continue to grow and develop science identities, or perhaps provide creative alternative entry points into the sciences, if they so decide. This contributes to the conversations that encourage perspectives that champion Western science to widen their field of vision to encompass a more integrated academic experience.

### **Limitations**

There are limitations to be considered when digesting this study. First, the quantitative sample was small. Across five schools, only 79 students participated in the study. Statistical power could be increased by increasing the sample size. Had I collected data for the sole purpose of this dissertation, perhaps a different sampling strategy would have garnered more participation. Second, there was no control group. I did not collect data from students enrolled in AP Environmental Science classes that were *not* using a project-based model of instruction.

Therefore, I was not able to use the PBL APES classes as a treatment group. Because of the nature of this analysis, I was unable to establish any causal links between PBL APES and students' intended career or majors in science.

As with any qualitative study, the purpose of this portion of my dissertation was to study in-depth the processes of students' development of AP and Science identities. As noted by Carlone & Johnson (2007), identity as a focus of study can become unwieldy when trying to account for all of the contributing factors that inform identity trajectories. By focusing specifically on AP and Science identities, I inherently could not focus on all of the students' other identities at play. While I aimed to account for the aspects of identity most germane to this particular study, there were certainly other identities happening that were beyond the scope of this study that may have played a role in students' AP and Science identities.

## **Conclusion**

With this study, I aimed to contribute to the literature on project-based learning, identity, and educational equity. The PBL APES curriculum is just one way to create space for students to enter and engage with the AP and Science worlds in meaningful ways that contribute to identification with those practices. It also is an opportunity to re-imagine and re-create those worlds to be more inclusive, valuing multiple perspectives and diverse backgrounds. By structuring the learning environment so that all students have integral roles, hold each other accountable to the learning, while offering access to the domains of AP and Science, students have the chance to grow into their AP and Science identities. If schools and districts continue to disrupt the "myths" of AP with creative approaches to advanced learning opportunities, the "realities" put forth by the College Board might actually become real.

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## Appendices

### Appendix A: Survey 1

Name: \_\_\_\_\_ Teacher: \_\_\_\_\_ Class Period: \_\_\_\_\_

#### Beginning of the Year Student Survey

2014-2015

Tell us about yourself

APES

Thank you for taking the survey today. We use your answers to help us make decisions about the course for future students like you. Your answers are confidential.

- There are many different opinions about humans' responsibility towards the environment. Some people value their own needs more than the needs of the environment while others believe that it is important to take care of the whole planet. We can represent these different opinions on a scale ranging from concern for yourself to concern for the whole planet. **Fill in the circle for the answer that best represents where *your* responsibility lies.**

Sustaining yourself only	Sustaining all human beings	Sustaining all living things	Sustaining all living and non-living things in a community	Sustaining the planet as a whole
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

- Why are you taking this class?** Rate each reason from 1 (not important) to 5 (very important)

	Not Important			Very
Important				
I want to earn college credit for passing the AP test. ----->	(1)	(2)	(3)	(4) (5)
I am interested in this subject. ----->	(1)	(2)	(3)	(4) (5)
I think taking this class will help me in college. ----->	(1)	(2)	(3)	(4) (5)
It is important for me to know this information. ----->	(1)	(2)	(3)	(4) (5)
It is a required class. ----->	(1)	(2)	(3)	(4) (5)

Other (please write in your reason/s below)

**3. Are you planning to take the AP test?**

- Yes
- Probably
- Probably Not
- No

**4. Have you taken other AP classes before this year? If so which ones?**

**5. What are your plans after you graduate from high school? Check all that apply:**

- Get a job
- Go to college
- Join the military
- I don't know
- Other: \_\_\_\_\_

**6. How many people do you know have gone to or are in college?**

- 0
- 1-5
- 6-10
- More than 10

**7. Who do you know who has gone to college or is in college now? Check all that apply:**

- Parent or Grandparent
- Brother or Sister
- Cousin or other relative
- Close friends
- Other people I know

**8. How many students in your school do you think will attend college?**

- Almost everyone
- More than half
- Half
- Less than half
- Almost no one

**9. Does your school help students prepare for college? If so, how?**

**10. I think this class will help me after I graduate by:**

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
Helping me earn college credit.	①	②	③	④	⑤ →
Teaching me skills and knowledge needed for college.	①	②	③	④	⑤ →
Preparing me to handle a college workload. -----→	①	②	③	④	⑤
Helping me learn to read and write at a college level. →	①	②	③	④	⑤
Helping me make informed decisions about the environment. --→	①	②	③	④	⑤
Helping me understand how the environment works. -----→	①	②	③	④	⑤
Teaching me how to live more sustainably. -----→	①	②	③	④	⑤

**11. Rate the following statements from 1 (Strongly Disagree) to 5 (Strongly Agree):**

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
I will use the things I learn in this class in the real world. ----	①	②	③	④	⑤ →
This class will help me learn things I need for college.	①	②	③	④	⑤ →
Most kids in my school -----	①	②	③	④	⑤ →

talk a lot about college.

Most of the teachers in ----- (1) (2) (3) (4) (5) →  
my school talk to students  
about college.

I am interested in-----→ (1) (2) (3) (4) (5)  
environmental issues

I believe my actions can make  
a difference in what happens (1) (2) (3) (4) (5) to  
the environment.

**12. Rate the following statements from 1 (Strongly Disagree) to 5 (Strongly Agree):**

Strongly disagree Disagree Neutral Agree Strongly Agree

Reading about science is (1) (2) (3) (4) (5)  
interesting..

Science textbooks are ----- (1) (2) (3) (4) (5) →  
hard to understand.

I have good strategies for ----- (1) (2) (3) (4) (5) →  
studying and doing homework.

I learn more when I discuss -- (1) (2) (3) (4) (5) →  
what I'm reading with my  
classmates.

I learn things from my----- (1) (2) (3) (4) (5) →  
reading assignments that I  
use in class.

I am good at writing ----- (1) (2) (3) (4) (5) →  
answers to teachers' questions.

My science teachers help ----- (1) (2) (3) (4) (5) →  
me understand what I read.

**More About You**

**13. Age:** \_\_\_\_\_

**14. To the best of your knowledge, what is the highest level of schooling that your mother has completed?**

- No school
- Elementary school
- Middle school/Junior high school
- Some high school
- Graduated high school
- Some college or technical school
- Graduated college
- Advanced degree (for example, MA, MS, PhD, MD, JD)

**15. Were your parents born in the United States or another country?**

- Both in US
- One in US, one in another country
- Both in another country
- Don't know

**16. How often do people in your home speak to each other in a language other than English?**

- Never
- Once in a while
- About half the time
- All or most of the time

## Appendix B: Survey 2

Name \_\_\_\_\_

### How My "AP Environmental Science" Class Went

Thank you for taking the time to complete this survey today. We're interested in learning more about your experiences in this class. All of your answers on this survey will be kept confidential.

1. There are many different opinions about humans' responsibility towards the environment. Some people value their own needs over the needs of the environment while others believe that it is important to sustain the planet as a whole. We can represent these different opinions on a scale ranging from concern for oneself to concern for the whole planet. Fill in the bubble for the answer that best represents where your concerns lie.

<b>Sustaining yourself only.</b>	<b>Sustaining all human beings</b>	<b>Sustaining all living things</b>	<b>Sustaining entire ecosystems</b>	<b>Sustaining the planet as a whole</b>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

2. Briefly explain your answer to the question above.

3. Do you think your opinion on this has changed since the beginning of the year? If so, what do you think contributed to that change?

4. Rate the following statements from 1 (strongly disagree) to 5 (strongly agree). Fill in the bubble for the number that best represents your opinion.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I am interested in environmental issues ----->	(1)	(2)	(3)	(4)	(5)
I believe people like me can make a difference. ----->	(1)	(2)	(3)	(4)	(5)
I think I know enough to make informed decisions about environmental issues. ----->	(1)	(2)	(3)	(4)	(5)

5. What career or field/s of study are you planning to pursue?

6. Has this changed since the beginning of the year? If so, do you think this course contributed to that change? If so, how?

7. How confident are you feeling about being successful in college? Fill in the bubble for the answer that best represents your opinion.

<b>Not at all confident</b>	<b>Somewhat confident</b>	<b>Very confident</b>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

8. Has your opinion about your chances of success in college changed since the beginning of the year? If so, how and why?

9. Rate the following statements from 1 (strongly disagree) to 5 (strongly agree). Fill in the bubble for the number that best represents your opinion.

In this class...	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I was usually interested in what we were doing. ----->	(1)	(2)	(3)	(4)	(5)
Some big ideas came up over and over again. ----->	(1)	(2)	(3)	(4)	(5)
We often moved on to a new topic before we really -----> understood the old one.	(1)	(2)	(3)	(4)	(5)
I usually really got into the activities. ----->	(1)	(2)	(3)	(4)	(5)
I often wished class would end. ----->	(1)	(2)	(3)	(4)	(5)
Things I learned early in the year helped -----> me understand later material.	(1)	(2)	(3)	(4)	(5)
I was often confused about why we had to learn -----> certain things in this course.	(1)	(2)	(3)	(4)	(5)
I actively participated. ----->	(1)	(2)	(3)	(4)	(5)
Mistakes were OK, as long as we learned from them. ----->	(1)	(2)	(3)	(4)	(5)
I usually felt like I contributed to our learning. ----->	(1)	(2)	(3)	(4)	(5)
I usually felt like my ideas were important to our learning. ----->	(1)	(2)	(3)	(4)	(5)
My mind often drifted away from what we were doing. ----->	(1)	(2)	(3)	(4)	(5)
When students worked together we usually learned more. ----->	(1)	(2)	(3)	(4)	(5)

In this class...	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I learned more working by myself than working with others. ----->	(1)	(2)	(3)	(4)	(5)
The teacher encouraged us to think for ourselves. ----->	(1)	(2)	(3)	(4)	(5)
We did a lot of "busy work" that didn't help us learn. ----->	(1)	(2)	(3)	(4)	(5)
We usually got to apply what we learned right after -----> we learned it.	(1)	(2)	(3)	(4)	(5)
Time passed really quickly. ----->	(1)	(2)	(3)	(4)	(5)
We learned how to solve problems on our own. ----->	(1)	(2)	(3)	(4)	(5)
My teacher often gave us a purpose or questions to answer -----> for our reading assignments.	(1)	(2)	(3)	(4)	(5)
The reading we had to do was hard to understand. ----->	(1)	(2)	(3)	(4)	(5)
I could get a good grade without doing the reading for this class. ----->	(1)	(2)	(3)	(4)	(5)
My teacher encouraged us to think about what we read and ask-----> questions.	(1)	(2)	(3)	(4)	(5)
The reading we did was interesting. ----->	(1)	(2)	(3)	(4)	(5)
I understood the readings better if my teacher had us write -----> down information on a chart, a handout, or in a log.	(1)	(2)	(3)	(4)	(5)

In this class...	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
The vocabulary and concepts we learned were difficult. ----->	①	②	③	④	⑤
We often used information from homework reading for -----> our projects or discussed it in class.	①	②	③	④	⑤
When we did writing assignments, the teacher helped -----> us understand what to do.	①	②	③	④	⑤
I could get a good grade without doing much writing in this class. -->	①	②	③	④	⑤

10. Rate the following statements from 1 (Not at all) to 5 (A lot). Fill in the bubble for the number that best represents your opinion.

How difficult was it to understand the following materials for this class:	Not at all	A little	Neutral	Some	A lot
Textbook----->	①	②	③	④	⑤
Internet sites----->	①	②	③	④	⑤
Material the teacher handed out to us----->	①	②	③	④	⑤
Teacher's lectures----->	①	②	③	④	⑤

How useful for your course projects or assignments was each of the following:	Not at all	A little	Neutral	Some	A lot
Textbook----->	①	②	③	④	⑤
Internet sites----->	①	②	③	④	⑤
Material the teacher handed out to us----->	①	②	③	④	⑤
Teacher's lectures----->	①	②	③	④	⑤

How useful for the AP test was each of the following:	Not at all	A little	Neutral	Some	A lot
Textbook----->	①	②	③	④	⑤
Internet sites----->	①	②	③	④	⑤
Material the teacher handed out to us----->	①	②	③	④	⑤
Teacher's lectures----->	①	②	③	④	⑤

How useful for class quizzes/tests was each of the following:	Not at all	A little	Neutral	Some	A lot
Textbook----->	①	②	③	④	⑤
Internet sites----->	①	②	③	④	⑤
Material the teacher handed out to us----->	①	②	③	④	⑤
Teacher's lectures----->	①	②	③	④	⑤

11. How challenging was this course compared to other science courses you have taken? Fill in the bubble for the answer that best represents your opinion.

A lot less challenging    Slightly less challenging    Equally challenging    Slightly more challenging    A lot more challenging

12. What were the most challenging things about this course?

13. How much did you learn in this course that you can use outside of school?

A lot less                      Slightly less                      About the same                      Slightly more                      A lot more

14. Did you take the AP exam for this course? Fill in "yes" or "no".    **Yes**                      **No (Skip to question #18)**

15. Compared to other AP tests, how much effort did you put into preparing for this AP test? Fill in the bubble for one answer.

A lot less effort    A little less effort    Equal Effort    A little more effort    A lot more effort    N/A: Did not take another AP Test

16. What helped the most in getting ready for the AP exam?

17. Was the AP exam important to you? Fill in the bubble for one answer.

Not at all important                      Somewhat important                      Very important

18. Why was the AP exam important or unimportant to you?

19. If you did not take the AP test, why not?

20. Is there anything else you'd like to share with us about your experiences in this course?

## Appendix C: Fall Interview Protocol

### University of Washington Knowledge in Action Study

Beginning of the Year Student Interview Protocol  
2014-15

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Thank you for agreeing to participate in this interview. I'm interested in hearing about your experiences in this class and get your suggestions on how we can improve this course for other students in the future.

I also want to explain that everything you share with me is confidential. Your name will not be used. This interview will be audio recorded so I can remember what you say. You may ask me to stop recording at any time, or you may stop the interview at any time when you feel uncomfortable.

---

#### About You in This Class/ School

1. Bring me up to date on this class. Tell me what EcoFootprint was about.
  - What have you been learning about?
2. How is the class going for you?
3. Tell me why you're taking this class?
  - How did you make that decision?
  - Did you talk to anyone about taking this class?
4. How does this class compare to other classes you're taking?
  - Similarities and differences?
5. In your opinion, what other kinds of things are interesting or important to learn in this class?
6. What kinds of things seem unimportant or irrelevant to you in this class?

#### Science & Stewardship

7. Do you talk to your friends or family about this class? (If yes) what kinds of things have you talked with them about? Probe: Have you talked to them about what you're learning?
8. Has what you learned in this class led to any changes in your daily life or your family's? Can you give me an example?

9. How would you explain the meaning of the word “sustainability” to someone in your family?
10. Has this class influenced how you feel about science? Please explain.

### **Advanced Placement**

*I want to ask you a little bit about your experience with taking an AP course, specifically this course.*

11. When you hear the term AP, what does that mean to you?
12. Who, in your opinion, should take AP classes?
13. If you were really struggling with something in this class, how would you get help? Do you have any real-life examples of that?

**Reading** Let’s talk about the reading you do for this class.

14. Tell me about the different kinds of things your teacher asks you to read for this class. I’m going to make a list as we talk.

*(Encourage students to provide an example if they name a category such as internet, textbook (ask about what they read in the textbook), handouts, newspapers, outside research books, etc. They may even be able to show you examples of the readings from their notebooks. Then you can ask, did you read other things in this unit that are similar? If students haven’t mentioned a category, prompt to see if they may recall something they read in this category.)*

15. Now let’s talk about the kind of homework your teacher gives you in this class.

Tell me specifically about kinds of things you are supposed to read for homework. *You can have students refer the list from #14 to get a sense of the range of types. Be sure to ask for specific examples of what they have been reading.*

**Prompt:** How does the homework reading usually go for you?

*(If kids say OK, or good, etc. ask them to tell you more. Use the prompts below.)*

**Prompts:**

- How often do you actually do it? What do you do with the information you read?
- What does the teacher do when he/she gives you a reading assignment for homework? How, if at all, does your teacher help you or discuss with you the homework reading?

**In general,**

- How much do you use your homework reading in class?  
*[show the scale below to prompt thinking. Then ask them to say a little more about that. HOW DO YOU USE IT?]*
- How useful is your homework reading for your projects?  
*[prompt for an example]*
- How challenging or difficult are your homework readings?  
*[use scale below to prompt thinking. Then ask them to say a little more about that—what makes it difficult/challenging or not difficult/challenging; prompt for an example]*
- How interesting are your homework readings?  
*[use scale below to prompt thinking. Then ask them to say a little more about that—what makes it interesting, are there different topics or types of reading that they find more or less interesting.]*

16. Now, let's talk about the reading that you do in class.

Tell me specifically about kinds of reading you read in class.

*You can have students refer the list from #14 to get a sense of the range of types. Be sure to ask for specific examples of what they have been reading.*

Prompt: How does that in-class reading usually go for you?

*(If kids say OK, or good, etc. ask them to tell you more, especially how it is structured in class and how it works. Use the prompts below.*

**Prompts:**

- How often do you actually do it? What do you do with the information you read?
- What does the teacher do when he/she gives you a reading assignment in class? How, if at all, does your teacher help or talk with you about what you're reading?

**In general,**

- How much do you use the reading you do in class?  
*[show the scale below to prompt thinking. Then ask them to say a little more about that—HOW DO YOU USE IT?]*
- How useful is that reading for your projects?  
*[prompt for an example]*

- How challenging or difficult are your class readings?  
*[use scale below to prompt thinking. Then ask them to say a little more about that- what makes it difficult/challenging or not difficult/challenging. Prompt for an example]*

- How interesting are the readings?  
*[use scale below to prompt thinking. Then ask them to say a little more about that- what makes it interesting, are there different topics or types of reading that they find more or less interesting.]*

17. In terms of the reading, what suggestions do you have about EcoFootprint for us to make this unit better for students like you in the future?

### **Future Plans**

18. As of now, what are your plans after high school?

19. Are there any connections between what you've done in this class and in thinking about those plans?

**Useful**

NOT AT ALL USEFUL	A LITTLE USEFUL	SOMEWHAT USEFUL	VERY USEFUL	EXTREMELY USEFUL
1	2	3	4	5

**Difficulty/Challenge**

VERY EASY	EASY	NEUTRAL	DIFFICULT or CHALLENGING	VERY DIFFICULT/CHALLENGING
1	2	3	4	5

**Interest**

NOT AT ALL INTERESTING	A LITTLE INTERESTING	SOMEWHAT INTERESTING	MODERATELY INTERESTING	EXTREMELY INTERESTING
1	2	3	4	5

## Appendix D: Spring Interview Protocol

# University of Washington

## Knowledge in Action Project

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### *End of Year Student Interview Protocol*

2015

Thank you for agreeing to participate in this interview. We are interested in hearing about your experience in this class and getting your suggestions on how we can improve this course for other students in the future. Everything you share with us is confidential. This interview will be audio-recorded. You may ask me to stop recording at any time or to stop the interview at any time if you ever feel uncomfortable.

---

1. **(TAKE OUT COURSE POSTER NOW)** Looking at the course poster here, can you tell me about which project cycles worked well for you and why? Which project cycles did you really get into and why?
  - a. What cycle/s or parts of a cycle helped you to learn the most?
  - b. What cycle/s did you find the most challenging? How was it challenging?
  - c. Were there things you learned in one cycle that you were able to use or build upon in other cycles?
  
2. Was this course was different from other courses you have taken? Tell me about what was different?
  - a. Did this course require you to think, learn, or participate differently than other courses you've taken?
  - b. Have you taken other AP courses? How does this course stack up against other AP courses in terms of the knowledge you've gained?
  
3. What are you taking away from this course experience that's of value to you personally?
  - a. Have you had any conversations about things learned in this course with people outside of school? Tell me about those.
  - b. How do you think about the environment now?
  
4. Tell me about the reading you did for this class (mention the different sources --textbook, handouts, websites, other).
  - a. First let's think about the reading you did in class.
    - Why kind? How much? How challenging?
    - How did you go about it (listen/prompt for what teacher did, what they did, how they used the tools and the info from the reading class?)
  - b. Now, let's think about the reading you did outside of class (homework, research, etc.)
    - Why kind? How much? How challenging?

- How did you go about it (listen/prompt for what teacher did, what they did, how they used the tools and the info from the reading class?)
  - c. How often did you do the reading? Did you find it necessary to be successful in the class or could you get away with not doing it? How did that work?
5. Tell me about the writing you did for this class (mention the different kinds—homework, completing tools, research, projects).
- a. First let's think about the writing you did in class.
    - Why kind? How much? How challenging?
    - How did you go about it (listen/prompt for what teacher did, what they did, how they used the tools and the info from the reading in their writing?)
  - b. Now, let's think about the writing you did outside of class (homework, research, etc.)
    - Why kind? How much? How challenging?
    - How did you go about it (listen/prompt for what teacher did, what they did, how they used the tools and the info from the reading in their writing?)
  - c. How often did you do the writing assignments? Did you find it necessary to be successful in the class or could you get away with not doing it? How did that work?
6. As of now, what are your plans for after high school?
7. Are there any connections between what you've done in this class and those plans? *[If yes, follow up with specific examples. If no, follow up with What kinds of things influenced those plans?]*
8. How would you describe yourself as a student? How, if at all, has that changed?
9. What kinds of classes have you especially liked? Why? What about classes you didn't like as much? What did you dislike about [name of class]?
- I want to ask you a little bit about your experience with taking an AP course, specifically this course.
10. What does AP mean to you?
11. How does this class fit with your ideas about AP, specifically AP science classes?
12. Who, in your view, should take AP classes? What has influenced your thinking about this?
13. Has this class been a good fit for you? [In what way? Or Why not?]

14. After completing this course, how would you describe what an Environmental Scientist does?
- a. what kinds of things do environmental scientists need to know and understand? .
  - b. What do you believe is the role of scientists in solving environmental problems?
15. Has this class influenced how you feel about science? Explain
16. What is your understanding of the meaning of “sustainability” and how it was used throughout this course?
17. Let’s look at some of the tools you have used in this class. Did any of these tools help you understand what you were learning in this class? Explain.
18. Is there anything else we haven’t asked that you want to share with us about your experience in this course?

## Appendix E: Code List

AP: = respect  
AP: AP is a lot of work  
AP: AP is for smart people  
AP: APES is easier than other AP classes  
AP: challenge = good  
AP: class is good (even without college credit)  
AP: college credit  
AP: complex thinking  
AP: Description of experience  
AP: difficult/challenging  
AP: for goal-oriented students  
AP: for hard working students  
AP: for serious students  
AP: for students who want to be challenged  
AP: good fit  
AP: good for college applications  
AP: Good teacher  
AP: Maturity/Adult-like  
AP: memorization  
AP: new to AP  
AP: not for me  
AP: prepares you for college  
AP: preview of college  
AP: saves money  
AP: special knowledge  
AP: stress  
AP: test prep  
AP: THIS AP course is different from others  
AP: This class is like other AP classes  
AP: vet  
CJ: competence  
CJ: competence lacking  
CJ: performance  
CJ: performance poor  
CJ: recognition  
CJ: recognition misattributed  
CJ: recognition negative  
Conflicting statement  
Conflicts with video  
Cycle: Eco-Footprint  
Cycle: Foods  
Cycle: Oceans  
FW: AP  
FW: Science

Good student  
hybrid space  
ID: AP  
ID: change agent  
ID: college  
ID: Constrained  
ID: description  
ID: disconnect  
ID: future selves  
ID: history-in-person  
ID: opportunity  
ID: science  
ID: science not  
Interest: AP  
Interest: Environmental Science  
Interest: lowered  
Interest: not interested  
Interest: Project  
Interest: Science (more generally)  
Likes the class  
metacognition  
Moments of change  
Participation  
PBL: authentic tasks  
PBL: constructivism  
PBL: Deep learning  
PBL: Disciplinary skills/practices  
PBL: Discussion  
PBL: group work  
PBL: learning by doing  
PBL: looping  
PBL: problems with PBL  
PBL: reason for learning  
PBL: roles  
Personal connection  
PLI: Access to the domain  
PLI: Access to the domain constrained  
PLI: Integral Roles  
PLI: self-expression  
PLI: self-expression constrained  
positioning  
positioning attempt  
positioning response  
Resource: family  
Resource: family (lacking)  
Resource: material

Resource: peer  
Resource: peer (lacking)  
Resource: teacher  
Resource: teacher (lacking)  
Struggles/challenges  
T Accountability for events  
T Accountability for events not  
T assessment  
T bias evident  
T goals for students  
T high area of knowledge  
T high point  
T low area of knowledge  
T perception of students  
T struggles/challenges  
Transfer opportunity