

## **Advanced Placement Environmental Science Curricula: Emphasizing Key Topics Through Content and Pedagogy**

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### **ABSTRACT**

Environmental education is a field of strong debate in the K-12 community, as teachers, school administrators, and policy makers decide where environmental science should fit in to standard curriculum. Advanced Placement Environmental Science (APES) is an environmental education program offered in science departments in many US secondary schools. APES courses are an important focus within the environmental education debate because of their emphasis on preparation for standardized tests and tensions between their roots in traditional science curriculum and the interdisciplinary nature of environmental issues. To investigate curricular and pedagogical techniques employed in APES courses, I surveyed 67 former APES students, interviewed 6 former APES students, and interviewed 5 current and former APES teachers. Respondents reported varied experiences in the course, with the majority emphasizing pedagogical differences between Advanced Placement (AP) test expectations and classroom expectations, and some indicating differences between their teachers' approaches and the content of the AP exam. Interview subjects reported that APES allowed for more interdisciplinary study and discussion of social context than most science courses, but that the AP exam does not emphasize that same interdisciplinary content, which influences teachers' curriculum and pedagogy choices. Many students perceived the most traditional techniques – strong reliance on a textbook, emphasis on the AP exam - as an impediment to learning. Culturally relevant pedagogy had the largest positive impact on student learning because of its connection to issues that students care about. These results suggest that connections between environmental science and social contexts may provide an effective way for students to learn about environmental problems in APES courses.

### **KEYWORDS**

science education, classroom pedagogy, standardized testing, Advanced Placement, environmental education

## INTRODUCTION

Since its inception at the turn of the 20<sup>th</sup> century, environmental education has moved from a focus on nature appreciation to the analysis of environmental problem solving and human impacts on ecosystems. In the context of the early conservation movement, environmental education emerged from “nature study,” which encouraged a general knowledge and valuing of natural beauties outside of human culture (Pauly 1991, Stevenson 2007). In the 1960s and 70s, schools began to transform their nature study programs into environmental science and studies programs that recognized humans as part of processes of environmental change (Stevenson 2007). This sparked environmental science classes to consider causes and solutions to environmental problems, typically focusing on explanations drawn primarily from the natural sciences, rather than drawing on sociological and political factors. Today, K-12 schools offer environmental education for many reasons, most commonly administering it within “science” departments of secondary schools – the departments that traditionally offer chemistry, biology, physics, and other similar courses (Cole 2007, Stevenson 2007). However, environmental science draws on more than just natural science content. Environmental Science is fueled by concern regarding pollution, overuse of natural resources, wildlife extinction, and other problems that are closely linked to social and cultural norms. These concerns inspired Rachel Carson’s *Silent Spring* and helped lead to the modern era of environmental management. Some educators have challenged the exclusive focus on natural sciences, reforming environmental education to include social justice, economics, politics, and culture (Cole 2007). Yet few K-12 environmental education classes have embraced this approach (Stevenson 2007). Moreover, there is no standard way for environmental education programs in K-12 schools to analyze environmental problems in terms of all the social, political and ecological factors that impact those problems.

Advanced Placement Environmental Science (APES) is a widespread secondary school environmental education program regulated by the College Board. The College Board is a U.S.-based private, non-profit organization that designs and administers Advanced Placement exams and other standardized tests. The College Board has some control over AP course curricula, as teachers must submit a syllabus to the College Board for approval before they can teach any Advanced Placement (AP) courses, including APES. The main function of the College Board in APES is to provide the AP exam at the end of each school year as a final evaluation of student

learning. According to the College Board, APES courses should support students in their future studies in environmental science in higher education (The College Board 2013). However, the College Board does not provide curriculum resources such as textbooks and instructional materials beyond AP test prep books, so teachers must locate and implement their own instructional materials. APES may encourage environmental action, although its course timeline does not outline a commitment to that action and the College Board does not provide standardized curriculum for the course. The stated goal of the course is to prepare students to study environmental science in college (The College Board 2013).

If the College Board's goal is to prepare students intellectually for college level environmental science classes, it is unclear how the College Board expects APES teachers to frame environmental problems. There is no set "environmental science" curriculum in colleges—environmental science courses focus on a range of social, political, and natural science topics. The field of environmental science was established and continues to be maintained within a climate of crisis and political controversy over social causes and possible solutions to environmental problems. Some environmental scientists believe that scientific findings must be considered in the context of associated political, economic and cultural processes, whereas others prefer to separate the natural science inquiry of environmental science from the politicized context of environmental controversy (Gottlieb 2005, Forsyth 2003). Furthermore, APES courses do not have a standardized pedagogy, which is comprised of the teaching techniques used by teachers to present content. It is unclear how APES instructors frame content and pedagogy concerning the causes of and solutions to environmental problems.

To better understand how APES instructors address environmental phenomena, I analyzed the framing of environmental issues in APES courses, and how that framing differs from AP test content. I also examined how APES teachers structure their courses in terms of pedagogy, how they approach specific environmental science topics - biodiversity loss, climate change, pollution, and environmental justice - as environmental issues, and how they frame possible causes and solutions of those problems. To answer these questions I conducted interviews with APES teachers and surveys and interviews with former APES students, focusing on the most commonly emphasized topics in the course, the causes and solutions that were emphasized for environmental problems, and the pedagogy used in classrooms to frame topics and problems.

## METHODS

I surveyed and interviewed former APES students and interviewed APES teachers to determine how curriculum was framed in the course. I studied how four key environmental topics - biodiversity loss, environmental justice, pollution, and climate change - were addressed in APES curricula, and teacher motivations for framing these problems in particular ways.

### Study System

To answer my central research question about how environmental science content is framed in APES courses, I interviewed AP Environmental Science teachers and former AP Environmental Science students attending UC Berkeley. I surveyed and interviewed students to understand how APES course topics were framed, and which topics were most emphasized. I then interviewed teachers to document how they framed environmental issues in their courses and why they made these choices. I focused on student and teacher perspectives because they have more direct experience with APES curricula than school administrators or College Board staff.

### Student Surveys

To document how former APES students perceive the framing of environmental issues in APES courses, I surveyed students by posting a Survey Monkey link on many UC Berkeley student Facebook pages. I also distributed my surveys to many professors who agreed to pass the survey along to their students or even administer it for extra credit in their courses (Table 1). All of the students surveyed were current UC Berkeley students. The majority of these (82.1%) were surveyed through an extra credit assignment presented to Environmental Science, Policy, and Management 50AC students in Fall 2014, and the other 17.9% were students that responded to the survey through links posted on Facebook groups. The ESPM 50 AC students showed slightly different demographics from randomly sampled students (Appendix A).

**Table 1. UC Berkeley courses that received an email about the APES Student Survey.**

<b>UC Berkeley Course</b>	<b>Course Description</b>
ESPM 100 ES	Introduction to the Methods of Environmental Science
ESPM 114	Wildlife Ecology
ESPM C11	Americans and the Global Forest
UGIS 82	K-8 Teaching and Inquiry-Based Lesson Design in the Science and mathematics Classroom
UGIS 188	Research Methods for Science and Mathematics K-12 Teachers
EDUC 131	Classroom Interactions in Science and Mathematics: A Focus on Equity and Urban Schools
ESPM 50AC	Introduction to Culture and Natural Resource Management
ESPM 175	Senior Research Seminar in Environmental Sciences

To understand how four key environmental topics (biodiversity loss, environmental justice, pollution, and climate change) were presented in APES classes, I structured the student surveys around those topic areas. I asked students which of the four main issues were most emphasized in the course, and, if they were presented as problems, what causes and solutions were associated with them. I also asked open-ended questions about the involvement of certain themes in course content (capitalism, ecological qualities of certain landscapes, etc.) and structured these questions for short, single phrase or single sentence answers so that students reported the first topic or thought that came into their mind after reading the questions (Appendix B). My goal in collecting open-ended and topic identification data was to understand the first things that pop into students' minds regarding APES content. I focused on the topics that students most readily remember from the course because these are most likely the topics that had the longest impact on them after the course (Chawla 1999).

### **Former Student Interviews**

I interviewed former students to more deeply understand their perspectives on the framing of topics and how closely APES curriculum was oriented toward the APES exam. I

asked them what topics they remembered most from the course as well as how causes and possible solutions to environmental problems were framed and which were most emphasized. I treated students' initial reactions to questions as the most important pieces of data. I digitally recorded respondents, noting places in the recording with important quotes and insights, then later transcribed text from the recording at these times that I highlighted in my notes.

### **Teacher Interviews**

I conducted interviews with teachers to further explore the curriculum choices themselves and address reasons behind them. I asked teachers about their chosen curricula emphasis, and used the same recording and transcription procedure that I used with students. I compared these responses with the responses from student surveys and interviews.

### **Data Analysis**

#### *Student Surveys*

To answer questions about the pedagogy and framing of environmental problems in APES courses from the student perspective, I compiled results from surveys and analyzed the frequencies of particular types of answers for short answer questions. For questions about the causes and solutions of the four main environmental problems that I analyzed in this project, I found frequencies of the top few responses in each category of cause and solution. For open-ended short answer questions about the course in general, I made coding schemes for each question based on the nature of the question. For example, for a question about how capitalism was addressed in relation to environmental problems, I coded responses based on whether capitalism as a theme was discussed or not, and assigned a label to each response based on that coding scheme. I then found the percentage of responses that reported capitalism as present or not present as a theme in the course.

*Teacher and Student Interviews*

I analyzed results from interviews by compiling frequencies of certain types of answers. For questions about the most emphasized topics in the course, I categorized responses by whether they fit most closely under biodiversity loss, pollution, climate change, or environmental injustice. For questions that explicitly asked about the framing of those four environmental topics, I analyzed how proximal (or in-depth) the causes and solutions provided by respondents were. I also used student answers about general experiences in the course to compare their courses with AP test expectations. I used all of this information to get a general understanding of the impacts of and approaches to APES content and pedagogy.

**RESULTS****Former Student Surveys**

Almost all survey respondents (98.5%) had taken APES after 2009. All survey findings reported below refer to this sub-population. About 60% of these students were from Southern California cities such as Los Angeles, Santa Barbara, etc. (Table 2). Most self reported as Asian/Asian American, White, or Latino and were UC Berkeley undergraduates and between the ages of 18 and 21 (Appendix A).

**Table 2. Locations of student survey reported AP Environmental Science classes.**

<b>Location</b>	<b>Percentage of Respondents</b>
Southern California	56.7
Bay Area	19.4
Central Valley	3.0
Sacramento Metro	1.5
Nevada	1.5
Washington	1.5
Florida	1.5
Georgia	3.0
Maryland	1.5
New Mexico	1.5

Thailand	1.5
South Korea	1.5

Students most often reported pollution and biodiversity loss as the most important issues in their classes and environmental justice as the least important issue (Table 3). When asked about the most common causes and solutions of the four topics, students tended to list the most obvious, proximate causes and solutions. For example, the majority of students listed “carbon dioxide emissions” as the most emphasized cause of climate change (Table 4).

**Table 3. Former-student rankings of environmental problems in terms of their emphasis in the course. (1=most, 4=least).**

	<b>Biodiversity Loss</b>	<b>Pollution</b>	<b>Climate Change</b>	<b>Environmental Justice</b>
Rank = 1	38.9%	34.3%	16.4%	9.00%
Rank = 2	20.9%	29.9%	37.3%	10.4%
Rank = 3	31.3%	29.9%	32.8%	4.5%
Rank = 4	7.46%	4.48%	11.9%	61.2%

**Table 4. Former-student reported causes and solutions of environmental problems.**

<b>Problem</b>	<b>Most Common Cause</b>	<b>%</b>	<b>Most Common Solution</b>	<b>%</b>
Biodiversity Loss	Invasive species	43.3%	Protect native species	38.8%
Pollution	Carbon dioxide emissions	25.4%	Limit carbon dioxide emissions	22.4%
Climate Change	Carbon dioxide emissions	46.3%	Limit carbon dioxide emissions	41.8%
Environmental Injustice	Lack of concern	19.4%	Increased environmental awareness	17.9%

When asked how their classes approached human causes of environmental problems, all but three students listed human aspects as some part of their course. About half of the students (50.7%) reported that humans were emphasized as a factor in environmental problems but not necessarily implicated for every problem. Only 38.8% reported that complex social and political



factors influenced environmental problems. One student describes overpopulation as indirectly leading to environmental problems, pointing to the importance given to:

*emphasis on overpopulation and lack of clear regulations on industrial greenhouse gas emissions*

Another student mentioned consumer culture, stating that:

*The human aspect was emphasized through how us as consumers were responsible for the environmental problems. It also emphasized how big corporations have instilled the instruments of the environmental problems into our daily lives.*

The majority of students (55%) reported that capitalism was addressed in some way as implicated in environmental problems. Respondents often described capitalism as implied in the course as a cause of environmental problems, but not directly addressed so as to critique the institution itself. Often students described how aspects or results of capitalism were discussed, but did not indicate that the institution was directly questioned. For example, one student wrote:

*We talked about how manufacturing and industrialization led to the rapid exhaustion of natural resources, and how such industries polluted the environment.*

Environmental policy was often addressed in APES courses, as 88.1% of students reported environmental policy as addressed in some way in their course. A few students further explained the relevance of environmental policy in their APES course, explaining whether policy was represented as positively, negligibly, or negatively affecting environmental problems. Of the students who reported environmental policy as part of course content, 5.1% reported that it was largely explained as a solution to problems, 3.4% reported that it had a negative or negligible influence, and 10.2% explained that it was presented in terms of a mix of positive and negative influences. Environmental justice was minimally addressed in APES courses, as 34.3% of students reported that it was not present, while 26.8% indicated that it was present with a description that indicated some misunderstanding of the term. For example, one student described environmental injustice as a problem that:

*People are not aware of their surroundings and uses of natural resources.  
Therefore this leads to the depletion of natural resources.*

In this paper, environmental injustice is regarded as negative impacts due to anthropogenic environmental destruction that affect poor and disadvantaged people more than those with power or financial protection. This students' response is inconsistent with that definition.

When asked about the ecologies of specific landscapes and how they influenced environmental problems, students listed many different types of responses. Some (29.9%) reported that this was not considered in the course, was present but did not explain its specific influence, or did not provide a useful answer. The largest number of responses with detailed explanations (16.4%) reported that ecology and landscapes were described in objective scientific terms, and largely divorced from environmental problems. The same number (16.4%) reported that ecological factors were emphasized in relation to environmental problems.

Most students (92.5%) took the AP Environmental Science exam. Students reported a mix of pedagogy and content differences in the classroom experience (watching movies, conducting labs, problem solving) that differentiated their classroom from the AP test. Just 26% of students reported significant content differences between their class content and AP content, often in the form of lessons that addressed local environmental issues where they lived.

### **Student Interviews**

Informants were UC Berkeley students who had taken AP Environmental Science in the past six years. Two of the students were from Maryland and Arizona, and the other four were from California – more specifically Fremont, Del Mar, San Diego, and Los Angeles. When asked about the most emphasized content areas, three students reported some form of pollution, and three reported biodiversity loss. The students found class content to be closely tied to textbooks picked by their instructors but not necessarily to the AP test. Interviewed students also listed other specific topic areas as highlighted in the course, including examples such as biomes, nuclear pollution, acid rain, and climate change. Most students described the class content as missing social aspects of environmental problems and solutions. Most felt well prepared for the AP exam, but reported some key elements present in their courses that the AP test did not

emphasize. Most students reported a focus on local environmental phenomena in their classes. Also, some students said that their courses asked them to look more deeply and critically at environmental topics than the AP test did. However, two students said their course emphasized the same or less depth of content than the AP test.

### **Teacher Interviews**

Of the five APES teachers interviewed, four taught the course in the San Francisco Bay Area (one in Alameda, one in Fremont, and two in San Jose) and one taught in a suburb outside Chicago, Illinois. They had started teaching the course in 2000, 2004, 2007, 2010, and 2014, respectively.

Each teacher emphasized unique topic areas in his or her curriculum, including sustainability with respect to climate change, soil quality for food production, human impacts on ecosystems, and air and water pollution, to name a few. Three of the five teachers reported that they model their syllabi directly on the AP exam, while two teachers thought of the test as secondary to their classroom curriculum but a useful motivator for students. None of the teachers reported that their content was identical to AP test content. For example, a teacher who said he closely followed the College Board outline also said that he brought in elements of environmental justice, which are not outlined by the College Board, to “humanize the course”. All interviewees reported addressing environmental justice issues, though one teacher felt that she only did so very briefly and indirectly. The four other teachers addressed environmental justice directly, three of whom did so with local examples that related to the students’ surroundings. All teachers reported emphasizing biodiversity loss, pollution, and climate change either once or repeatedly in the course.

Some teachers emphasized complexities inherent in environmental problems and the challenges associated with solving them, rather than simplifying them as problems with clear solutions. All teachers reported developing students’ analysis skills as a course goal; they trained students to think critically about environmental problems and their personal impacts on the earth. Accordingly, one teacher stated that:

*I hope that they strengthen their skills in evaluating environmental issues.  
It’s easy to say ‘oh well we have this issue, then ok here’s the solution,’*

*but they don't think about who could be affected. So like, for example, something as simple as...carbon dioxide emissions from cars. The simple solution is ok get people to stop driving. And I hope by taking this class they understand 'well, it's not that simple.'*

Although all teachers reported that climate change, biodiversity loss, and pollution were the highest priority in the course, nearly all teachers claimed that they addressed environmental justice directly as a supplement to the standard APES test expectations. One teacher described her class as somewhat of an environmental studies class, as she incorporated human needs into problem solving in her course:

*You do consider, not just the environment, or biodiversity and that kind of thing, but also evaluate, or I guess consider, the human need, and I guess economics related to those needs that humans have.*

## DISCUSSION

Student and teacher accounts of AP Environmental Science courses reveal a range of approaches to the content and pedagogy associated with environmental topics. Many students and teachers reported that APES courses were less oriented to the AP exam than other AP courses. Student and teacher perceptions generally differed concerning how environmental justice and environmental policy were addressed in the course; teachers reported that environmental justice and human impacts were presented as central issues, whereas students generally reported that these were secondary. This observation may suggest inconsistencies between what teachers are teaching and what students are learning. The variety of pedagogy reflects a lack of structured curriculum provided by the College Board, and teachers report that the College Board and school administrators do not usually present many strict curriculum requirements. Similarly, most student interviewees felt that APES was one of the “easier” AP science exams. The inconsistency between student and teacher perspectives suggests the possible need for an improvement in formative assessment – assessment of student learning throughout the course to continually improve outcomes. The varied pedagogy and content across the course and perceived lack of pressure on teacher curriculum suggests that the course has the potential to increase demands on students for critical thinking about environmental topics and problems.

## Topic Emphasis

The heavy focus on biodiversity loss, climate change, and pollution that students and teachers reported results from many factors. First, the College Board outlines these topics as the highest priorities for the course (The College Board 2013), so APES teachers usually had that expectation in mind when emphasizing these areas. This focus relates to the higher value given to natural science education in K-12 schools. Science classes tend to emphasize these topics more heavily than social science topics because natural sciences are considered more technical and lucrative, and science education to date has largely focused on objective science because of the pressures of policy makers and standardized testing agencies (Guskey 2003, Stevenson 2007). One teacher described the need for students to keep a focus on natural science systems, stating that:

*Everybody should understand, you know it's not a course in environmentalism at all, it's a course in understanding environmental systems and understanding the impact that humans have on those systems. And adjustments that we can make to change that.*

This teacher emphasized that AP Environmental Science was mostly meant to give students a clear understanding of environmental systems, so that when they later analyzed the problems in those systems, they would have a solid foundational understanding of them. This need to study science as factual and irrefutable, relying on a linear transmission of knowledge from the teacher to the student, is linked to American schools' traditional approach to learning. American K-12 schools tend to neglect discussion and argumentation in favor of simple information transfer. This is because of the historical role of schools in maintaining the status quo, which is contradictory to the goals of societal change that are foundational to environmental education (Stevenson 2007).

The contradictory reports from students and teachers about the inclusion of environmental injustice in course content suggest inconsistencies between the content taught and the content remembered by students. According to students, environmental injustice was usually not studied in APES classes, which suggests a lack of focus on the political and moral implications of environmental decisions. For many environmental problems, students most

commonly identified material causes as opposed to sociopolitical and cultural causes. Causes and solutions that may be inherently social were not considered, even though they are integral to the root causes of the problems (Forsyth 2003). All teachers, however, reported addressing environmental justice in some way.

The inconsistencies between student and teacher reports of APES content emphasis could stem from many issues. The difference in location between students and teachers in this study could easily explain this inconsistency. Student survey and interview respondents were largely from Southern California, whereas teachers were largely from Northern California, so these two areas could have very different teaching practices. However, if (upon expansion of the study) reports from Southern and Northern California teachers are similar regarding environmental injustice content, there could be deeper pedagogical issues leading to the inconsistencies between student and teacher accounts. Formative assessment – tests, quizzes, and projects that monitor student learning to aid teachers in structuring subsequent content – could be lacking (Guskey 2003). This would explain why students do not remember pieces of content that teachers reported that they addressed. Also, the AP test lacks focus on complex social and political factors in environmental problems (The College Board 2013), so the memories that students have of test content could override their memories of lessons in the course that went beyond AP test content.

### **Causes of and Solutions to Environmental Problems**

Surveyed students generally identified the obvious, proximate causes of and solutions to environmental problems, rather than indirect or root causes and more socially complex solutions. Similarly, students often report that AP courses tend to cover breadth rather than deep content (Parker et al. 2011). Interviewed students also commonly reported that they were rarely asked to think through the complexities of environmental problems or question the institutional “status quo” in society. Instead of thinking critically about the complexities and systems that may lead to environmental problems, the class focuses on the most proximate causes. For example, when discussing climate change, many educators focused on CO<sub>2</sub> emissions independently, without addressing capitalism and consumer culture that may be driving emissions. Several students describe the general lack of critical analysis in their courses, one stating that:

*A problem with AP tests in general, and AP classes in general is that*

*there was much more of an emphasis on memorizing facts than critical thinking. I just felt like I was reading this dry textbook and doing worksheets that asked questions directly out of the book.*

Without critically analyzing all of the systems at play surrounding environmental problems, students may be unable to make positive decisions to impact them (Liu and Lin 2015). They have the false view that environmental problems are one-dimensional and that the solutions are obvious. When thinking about climate change, if students are only taught to think directly about “CO<sub>2</sub> emissions,” they will not have any experience considering the complex institutional and cultural changes that must be made to reduce emissions. Without those discussions, they may think that it is impossible (or simple) to reduce carbon emissions because they have not thought through the complex sociopolitical interactions involved in reducing those emissions (Stevenson 2007). When science education does not address the social issues implicated in science fields, students get the false impression that these fields are purely technical (Sarewitz 2004). One cannot understand environmental problems without understanding the social processes inherent in them (Stern 1993, Forsyth 2003).

### **Classroom Pedagogy**

#### *Teaching to the test*

Student survey respondents often described pedagogical aspects of their APES courses when asked how they differed from AP test content. The APES course catalog strictly emphasizes environmental problems in the natural sciences and ignores many social aspects of their problems and solutions (The College Board 2013). Some student interviewees felt that the AP exam did not look as deeply at environmental problems as did their course, while others felt that the AP exam was much more detailed and demanding than their course. Two students describe contrasting experiences in the course. The first stated that:

*I think that the AP test was actually more specific and detailed than was taught in class. Because I thought my class was pretty detailed and specific ... but, yeah the test I remember was just really tricky, I feel like there was just fact memorization, not so much big ideas...I remember coming out of the test thinking “I did not know a lot of these things” and I guessed on a lot.*

But the second student had a very different experience:

*In class we'd come at things from a sort of qualitative and quantitative manner, and I guess the AP test wanted that too, but in a much more concise manner. I think in the class we were kind of able to explore, of the topic we were given, kind of exploring whatever interests us most.*

Interviewees who reported close similarities between the test and the class often also reported dissatisfaction with the level of critical thinking in the course and tended to have trouble remembering specific topics. This reflects the inability of many tests to accurately and meaningfully measure student learning. When students are prepared solely for a test that has not been designed well to measure their learning, they won't learn much (Guskey 2003). Many students reported that APES demanded rigorous fact memorization, but lacked a focus on critical analysis, while others thought the class was simply too easy. One interviewee commented on the impact of the lack of critical analysis in the course, stating that:

*I feel like the AP class I took did not really encourage the student to think about the issues, and those big topics to the depth that we do in college, and I kind of wish it did...it was just a really uninspiring, and yeah, I just wish the classes in high school more reflected the classes in college.*

Similarly, when asked about the non-academic benefits of AP and International Baccalaureate (IB) classes, students typically don't mention general problem solving and critical thinking practice (Foust et al. 2009). This is likely because of an emphasis on breadth of learning rather than depth, which is a common criticism of AP and IB exams (Parker et al. 2011). Many educators believe that tests must address all five levels of Bloom's Taxonomy—knowledge, comprehension, application, analysis, synthesis, and evaluation (Brown and Reeve 1988). One teacher cited the focus on breadth of knowledge as a hindrance to teaching the higher levels of content required for true understanding, pointing out that:

*We wish there were more [labs], but it's always that balance between breadth and depth because they want you to cover so much in so little time.*

Most other teachers also mentioned that labs, fieldwork, or projects took a back seat to the breadth of content required to prepare for the AP exam. This is a hindrance to students, which shows in their ability to remember the course material. Most remembered many disconnected facts from the course, but could not remember their importance to the course or the big ideas in the course.



### *Culturally Relevant Pedagogy*

APES may be able to incorporate culturally relevant education—curriculum and pedagogy related to the personal lives, interests, and environments of students in the course—more easily than other science courses. Many students indicated that their personal experiences related to the course content were an important part of APES. According to interview respondents, discussion of pollution and biodiversity loss issues often concerned local contexts. One student explained his course’s emphasis on the local environment, saying that:

*Habitat destruction was the main thing...we always used the Chesapeake Bay as the nearest case study. We would have optional field trips...to look at the marshes for instance, and see how those were receding. Or like, their roll within detoxifying the water, providing nutrients, habitat.”*

This student vividly remembered the content associated with the fieldwork and local context in his class. Interview respondents consistently showed that the topics related to students’ local environments were the most memorable topics months and years after the course. All of the teachers interviewed also described using local and personal environmental problems to establish context with students. This is one way that APES can demonstrate place-based education in some communities and its effectiveness. Teachers use this technique because it usually has a positive impact on student learning by increasing engagement and content retention (Zandvliet 2013, Bogner 1998). Studies on the lasting impacts of environmental education also support the idea that local context and issues that “hit home” have the strongest impacts on students’ commitment to environmental action later (Bogner 1998, Chawla 1999, Chawla 2007, Kollmuss and Agyeman 2002).

### **Limitations and Future Directions**

Access to teacher respondents was limited in this study, though this does not greatly undermine the inference of my findings concerning the practices of AP Environmental Science teachers in the rest of the United States. The teachers that I interviewed explained their responses in the context of the AP program and science education in general, so their responses likely have much in common with other APES teachers in the rest of the country. However, these teachers

largely taught in the Bay Area and therefore may have unique perspectives because of the social and cultural differences between the Bay Area and other parts of the United States. A larger sample size of APES teachers from many parts of the United States would help infer the impact of location on approaches of APES teachers.

Some of the data from student survey respondents may be unreliable because of students' knowledge of survey question topics from other coursework and the time passed since the respondents took APES, but the surveyed population still provides a start in answering questions about the student experience in APES. In the survey I asked questions about environmental injustice; first, what were the emphasized causes and solutions, and second, how was it addressed. Many students indicated specific causes and solutions, then later wrote that environmental justice was not addressed. This implies that students were possibly pulling from other sources of knowledge, which makes answers about specific course content possibly unreliable. However, in this study I generally focused on the initial reaction of respondents as the most important impact of the course. If students remember to mention something very specific in a short answer question about a course they took years ago, that means it made a big impact on what they learned. With this in mind I can infer from my collected data that California AP Environmental Science students do not remember pieces of environmental science content because it was either not covered in the course or not made important enough for them to remember years later.

Given that the most significantly limiting factor in the methods of this study was the poor access to survey and interview respondents, future studies would benefit from an expanded respondent pool. More extensive study is needed to know what proportions of APES students and teachers are focusing on what topics. In this study, I was not able to sample respondents who were representative of the demographics of the Bay Area. It would be ideal to access respondents who had taken APES courses at a spectrum of schools representing the demographic diversity of the region. Future studies should also look at the socio-economic, political, and ethnic factors that influence APES content framing and pedagogy. This type of study would connect to place-based curriculum, as socio-economic, political, and ethnic factors that are also linked to geography.

## **Broader Implications and Conclusion**

AP Environmental Science classes emphasize a broad range of topics to illustrate environmental problems, and no one class is the same. Student survey respondents and interviewees generally reported a superficial framing of the causes and solutions associated with environmental problems, showing that the course suffers from the emphasis on breadth of knowledge to maintain its AP distinction. Thus, many APES students may not see the complexities of environmental issues after taking the course, which leaves them ill equipped to work toward environmental solutions. A lack of formative experiences or discussions has the potential to discourage students from studying environmental science in the future, or inhibit their ability to solve environmental problems (Sarewitz 2004). The few students who had experienced a project-based and place-based curriculum saw the course more positively than other respondents.

Teachers reported very different perceptions of the course than students. This means that better systems to assess student learning should be implemented in APES courses, as teachers and students had very different ideas about what they learned from the course. Students should also have opportunities for formative experiences outside the classroom while engaged in the course, as these experiences were remembered most vividly by students and would help solidify content knowledge and long-term impacts on students. Finally, in this study I found that students and teachers saw the AP exam as having little to no positive impact on student learning. The College Board should therefore consider ways to improve its testing practices to increase student learning about all the complexities of Environmental Science.

## **ACKNOWLEDGMENTS**

Patina Mendez and Kurt Spreyer provided constant technical and moral support throughout this project. Kurt functioned as my mentor for the project, met with me anytime I asked, and gave me access to valuable survey respondent sources. My project workgroup, “The Mind Gap,” also gave essential feedback and moral support for my drafts throughout this project. Finally, all the students and teachers who filled out the survey and participated in interviews were critical to making this project possible.

## REFERENCES

- Bogner, F.X. 1998. The influence of short-term outdoor ecology education on Long-Term Variables of Environmental Perspective. *Journal of Environmental Education* 29:17.
- Brown, A. L. and R. A. Reeve. 1988. Bandwidths of competence: The role of supportive contexts in learning and development. *Learning and Development*: 173-216.
- Chawla, L. 1999. Life Paths Into Effective Environmental Action. *Journal of Environmental Education* 31:15.
- Chawla, L. and D.F. Cushing. 2007. Education for strategic environmental behavior. *Environmental Education Research* 13:437–452.
- Cole, A. 2007. Expanding the Field: Revisiting Environmental Education Principles Through Multidisciplinary Frameworks. *Journal of Environmental Education* 38.2:35-45.
- Forsyth, T. 2003. *Critical Political Ecology: The Politics of Environmental Science*. Routledge. New York, New York.
- Foust, R.C., H. Hertberg-Davis and C. M. Callahan. 2009. Students' perceptions of the non-academic advantages and disadvantages of participation in Advanced Placement courses and International Baccalaureate programs. *Adolescence* 44:289-312.
- Gottlieb, R. 2005. *Forcing the Spring: The Transformation of the American Environmental Movement*. Island Press. Seattle, Washington.
- Guskey, Thomas R. 2003. How Classroom Assessments Improve Learning. *Educational Leadership* 60:6-11.
- Kollmuss, A. and J. Agyeman. 2002. Mind the Gap: why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental Education Research* 8:239–260.
- Liu, S. and H. Lin. 2015. Exploring undergraduate students' mental models of the environment: are they related to environmental affect and behavior? *The Journal of Environmental Education* 46:23-40.
- Pauly, P.J. 1991. The Development of High School Biology: New York City, 1900-1925. *Isis* 82:662-688.
- Parker, W., S. Mosborg, J. Bransford, N. Vye, J. Wilkerson and R. Abbott. 2011. Rethinking Advanced high school coursework: tackling the depth/breadth tension in the AP US Government and Politics Course. *Journal of Curriculum Studies* 43: 533-559.

- Rottle, N.D. and J.M. Johnson. 2007. Youth Design Participation to Support Ecological Literacy: Reflections on Charrettes for an Outdoor Learning Laboratory. *Children, Youth, and Environments* 17:484-502.
- Sarewitz, D. 2004. How science makes environmental controversies worse. *Environmental Science and Policy* 7:385-403.
- Stern, P.C. 1993. A second environmental science: human-environment interactions. *Science* 260: 1897-1899.
- Stevenson, R.B. 2007. Schooling and environmental education: contradictions in purpose and practice. *Environmental Education Research* 13:139–153.
- The College Board. 2013. Environmental Science Course Description.
- Zandvliet, David. 2013. *The Ecology of School*. Sense Publishers. Rotterdam, The Netherlands.

**APPENDIX A: SURVEY DEMOGRAPHICS****Table A1. Demographic information of student survey respondents**

	<b>ESPM 50AC Students (%)</b>	<b>Randomly Sampled (%)</b>	<b>Total (%)</b>
<b>Ethnicity (self reported)</b>			
asian	47.3	0	38.8
white	34.5	58.3	38.8
latino	7.27	0	5.97
asian+white	5.45	8.33	5.97
latino+white	0	8.33	1.49
latino+asian	1.82	0	1.49
Native American	0	8.33	
Middle Eastern	0	8.33	
none	7.27	0	
<b>Gender (self reported)</b>			
Female	43.6	50	44.8
Male	40	33.3	38.8
Non-binary	0	8.33	1.49
none	16.4	0	13.4
<b>Current Year at UC Berkeley</b>			
first year (including transfer)	69.1	N/A	N/A
second year	18.2	N/A	N/A
third year	3.64	N/A	N/A
fourth year	0	N/A	N/A
fifth and above	1.82	N/A	N/A
<b>Area of study</b>			
College of Natural Resources	30.9	41.7	32.8
Computer Science	14.5	0	11.9
Molecular Cell Biology	3.64	0	2.99
Integrative Biology	3.64	8.33	4.48
Business	12.7	0	10.4
other	10.9	16.7	11.9
undecided	14.5	8.33	13.4
no response	9.09	8.33	8.96

**APPENDIX B: STUDENT SURVEY**

**My name is Carly Clusserath and I am conducting this survey for my UC Berkeley Environmental Sciences senior thesis project on AP Environmental Science curricula. Your answers are anonymous and will only be used for my senior thesis project. If you have any questions please contact me at carlyclusserath@berkeley.edu**

\* 1. Did you take AP Environmental Science in High School?

\* 2. What was your reason for not taking AP Environmental Science in high school?

3. List your zipcode or hometown (city and state) when you were in high school (include multiple if necessary).

4. List any course options your high school offered that were similar to AP Environmental Science.

option 1

option 2

option 3

5. Did you take any of the above classes? (If so, list them)

**This page asks questions about how environmental problems were presented in your high school AP Environmental Science class. Please DO NOT reference perspectives from coursework other than AP Environmental Science.**

6. List any course options your high school offered that were similar to AP Environmental Science.

option 2

option 3

7. Did you take any of the above classes? If so, list them.

\* 8. During which school year did you take AP Environmental Science?

▼

\* 9. Did you take the AP Environmental Science test?

- yes
- no

\* 10. If you did take the AP test, what score did you get?

- 5
- 4
- 3
- 2
- 1
- did not take the AP test

\* 11. Rank the following topics in the order emphasized in your AP Environmental Science class (1=most, 4=least)

<input style="width: 40px;" type="text"/> ▼ biodiversity loss	N/A
<input style="width: 40px;" type="text"/> ▼ environmental injustice	N/A
<input style="width: 40px;" type="text"/> ▼ pollution	N/A
<input style="width: 40px;" type="text"/> ▼ climate change	N/A



**The following are examples of causes of and/or solutions to environmental problems.**

**Causes**

invasive species  
 pollution  
 inequitable distribution of natural resources  
 (lack of) environmental policies  
 social (in)equality  
 overpopulation  
 lack of concern  
 economic systems  
 (lack of) physical infrastructure  
 (lack of) technology  
 consumer choices  
 overuse of resources  
 land use change  
 carbon dioxide emissions  
 other (please specify)

**Solutions**

protection of native species  
 control of pollution  
 redistribution of natural resources  
 environmental policies  
 improved social equality  
 limit population  
 increased environmental awareness  
 restructuring of economic systems  
 (lack of) physical infrastructure  
 (lack of) technology  
 consumer choices  
 conservation of resources  
 conservation of land resources  
 limit carbon dioxide emissions  
 other (please specify)

**For the next four problems, identify at least one cause and one solution, as emphasized in your AP Environmental Science class. DO NOT draw from any coursework outside AP Environmental Science. You may use any words/phrases any number of times.**

**\* 12. Biodiversity Loss (if applicable)**

cause:

solution:

other causes:

other solutions:

**\* 13. Environmental Injustice (if applicable)**

cause:

solution:

other causes:

other solutions:

**\* 14. Pollution (if applicable)**

cause:

solution:

other causes:

other solutions:

\* 15. Climate Change (if applicable)

cause:

solution:

other causes:

other solutions:

\* 16. Indicate your level of agreement with the following statements.

	Strongly Disagree	Disagree	Neither Disagree Nor Agree	Agree	Strongly Agree
My AP Environmental Science Teacher was passionate about environmental problems.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My AP Environmental Science class emphasized the human causes of environmental problems.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My AP Environmental Science class presented concepts beyond those in the class textbook or AP test book.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My AP Environmental Science teacher strongly encouraged students to take the AP test in Environmental Science.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

\* 17. In 3 sentences or less, describe the ways your AP Environmental Science class addressed environmental problems differently from the AP test.

\* 18. In 3 sentences or less, describe how human causes of environmental problems were emphasized (or not) in your AP Environmental Science class.

\* 19. In 3 sentences or less, describe how the ecological qualities of specific landscapes were considered (or not) in relation to environmental problems in your AP Environmental Science class.

\* 20. In 3 sentences or less, describe how capitalism was discussed (or not) in relation to environmental problems in your AP Environmental Science class.

\* 21. In 3 sentences or less, describe how environmental injustice was discussed (or not) in your AP Environmental Science class.

\* 22. In 3 sentences or less, describe how environmental policy was discussed (or not) in relation to environmental problems in your AP Environmental Science class.

23. If you would be willing to participate in a 20-30 minute follow-up interview, please provide the following:

**Name**

**Email Address**

**Phone Number**

24. List your zipcode or hometown (city and state) when you took AP Environmental Science.

25. Please list your gender.

26. How would do you identify yourself? (check all that apply)

Asian/Asian American

White

Latino

African American/Black

Pacific Islander

Native American

Middle Eastern

Other (please specify)

27. What is the highest level of education you have completed?

**If you answered "some college" or "some graduate school" to the question above, please answer the following questions:**

28. What is your area of study? (or intended area of study)

29. What is the most recent educational institution you have attended/are attending?

**Thank you for taking this survey!**

30. Any last questions or comments?

### **APPENDIX C: STUDENT INTERVIEW QUESTIONS**

In what city and state did you take AP Environmental Science?

What main environmental problems do you remember the most from the class?

How did your teacher incorporate labs and fieldwork?

How much of an emphasis did your teacher put on the AP test?

How did your teacher address social aspects of environmental problems and solutions?

Describe how your class addressed:

Climate Change?

Biodiversity loss?

Pollution?

What does environmental justice mean to you?

Environmental justice?

Do you remember any differences between the ways your teacher seemed to approach environmental problems/solutions, and the way the AP test expected you to address them?

What thoughts do you have about AP Environmental Science course content now that you have taken more environmental science and environmental studies classes since high school?

Do you feel that the course impacted your interest in environmental improvement?

Final thoughts?

## APPENDIX D: TEACHER INTERVIEW QUESTIONS

City and State, Public/private school?

Why did you start teaching AP environmental science?

Content wise, what would you say is the big focus for the course (or two or three points of focus)?

What do you think is the primary motivation for that focus?

Describe how your class addresses:

Climate Change?

Biodiversity loss?

Pollution?

What does environmental justice mean to you?

Environmental justice?

What kinds of pressures are present that you must respond to when deciding on curriculum?

Do you incorporate labs and fieldwork? Why?

In what ways do you address social aspects of environmental problems and their solutions? Why?

How much of an emphasis do you put on the AP test? (i.e. Do you model a lot of the class activities on it?) Why?

What is your primary goal for students to accomplish when they finish your class?

Final thoughts?