Unequal Opportunity in Environmental Education: Environmental Education Programs and Funding at Contra Costa Secondary Schools

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Abstract Unequal opportunity in education threatens to deprive low socio-economic status (SES) students of quality schooling in all subject areas. This study investigates the relationship between the SES of students at public high schools and the time and funding those schools spend on one specific subject area, environmental education. Surveys of environmental science teachers and science department chairs at Contra Costa public high schools showed no significant correlation between SES and hours of student involvement in a school's environmental education opportunities. Interviews with principals and district financial officers revealed that as SES of students at a school increases, the absolute amount spent on environmental education increases while no significant correlation was shown with the amount spent relative to total budget. Surveys showed that though schools characterized as low SES provided approximately the same amount of environmental education hours as high SES schools, they only spend about one-fifth the amount of money on those programs. Although better funding allows high SES schools to spend a larger dollar amount than low SES schools on environmental education, low SES schools manage to provide comparable amounts of environmental education hours possibly due to student funding and motivated faculty.

Introduction

Environmental Education In 1990, Congress passed the National Environmental Education Act providing a national framework to increase environmental literacy, acknowledging education as an important tool in decreasing negative environmental impacts (US EPA 1990). In California, the education code encourages the development of educational programs in schools that "build necessary attitudes of stewardship toward the maintenance of the quality of our common environment" and requires teachers to include environmental education in the curriculum for primary and secondary levels (CA Legislative Counsel 2006). The state, however, does not address the specific content of this conservation education, its execution in schools or the quantity required.

Actual definitions of environmental education are numerous and vague. The definition developed for this study is education *about, in* and *for* the environment as evident in the form of four components: environmental science classes which represent education *about* the environment; outdoor education field trips which are education *in* the environment; environmental clubs or academies which constitute education *for* the environment; and student gardens which can consist of all three—education *about, in* and *for* the environment—depending on the program (Palmer and Neal 1994; Palmer 1998; Lee and Williams 2001; Tung, Huang and Kawata 2002).

Environmental Education and Justice Environmental education is important at a young age not only to promote understanding of and stewardship toward the environment (CA Legislative Counsel 2006) but also to bring about awareness of potential environmental hazards (Institute of Medicine 1999). According to the U.S. Environmental Protection Agency's Office of Environmental Justice, environmental justice means that "no group of people, including racial, ethnic, or socioeconomic group should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies" (US EPA 1998). Research has shown repeatedly that health hazards are unequally distributed by SES and, even more so, race (Brown 1995). The Institute of Medicine's Committee on Environmental Justice identifies the relationship between environmental education and environmental justice stating that students who learn about environmental health and safety will be less vulnerable than their parents to acts of environmental injustice. On the basis of numerous reports, the committee

advises that state education programs be adopted which educate children in environmental health *especially* those students "in areas of heightened risk" in order to reduce these populations' susceptibility to environmental injustice (Institute of Medicine 1999).

Unequal Opportunity in Education Although legal segregation in schools has ended, educational opportunities available to minority students have continued to be significantly separate and unequal. Today two-thirds of minority students attend schools which are mainly minority. These schools are under funded and have significantly fewer resources than schools with mostly white students resulting in poorer quality and quantity of education (Darling-Hammond 1998). The lack of resources at predominantly minority and low-income family schools threatens to deprive low SES students of environmental education in particular, but no previous studies have tested this hypothesis.

This study explores whether socio-economically disadvantaged students have unequal environmental education opportunities as assessed by three measures: hours of student involvement in environmental education activities, dollars spent on environmental education programs, and proportion of budget spent on environmental education programs. Using Contra Costa County public secondary schools as a case study, this project investigates whether the quantity of time and funding for environmental education at high schools decreases as the SES of the students at the school decreases through three hypotheses. The first hypothesis is that as students' SES decreases the hours students are involved in the components of environmental education also decreases. Second, as students' SES decreases I hypothesize a decrease in money spent on the environmental education components. Lastly, I hypothesize a decrease in the percent of total budget spent on the environmental education components, a relative measure of funding, as students' SES decreases.

Methods

To test these three hypotheses data on one SES variable and three environmental education variables were collected. The explanatory variable used to represent SES was the percentage of students at a school considered Socio-Economically Disadvantaged (SED). A student characterized as SED is defined by the California Department of Education (CDE) as one who

participates in the free or reduced-price lunch program[1] *or* whose parents both have not received a high school diploma (CDE 2006). The first dependent variable which represents *time* spent on environmental education is hours of student involvement in the environmental education components per student at the school. The two other dependent variables represent *money* spent on environmental education. One is an absolute value: the dollars spent on the environmental education components per student at the school. The other is a relative figure: the percentage of the total school budget spent on environmental education components.

The study covered public secondary schools in Contra Costa County[2]. A list of the twenty-seven public high schools in Contra Costa County was accessed from the CDE website (see Appendix A). The data on percentage of SED students at each school was compiled from the CDE website. The CDE website also provided data on school size (number of students) and state standardized test scores (Academic Performance Index or API).

The first part of the study investigated how the amount of environmental education at a school, in terms of hours of student involvement, is related to the SES of the school's students. Phone and email surveys with the environmental science teacher or the science department chair at each high school determined the presence, quantity and students involved this year in the following environmental programs and activities: environmental science[3] classes (Advanced Placement and/or College Prep); outdoor fieldtrips (local and/or distant[4]); environmental clubs; and student gardens (see Appendix B for the Teacher/Science Chair Survey). Each of these components of environmental education was multiplied by an exposure factor in order to estimate the amount of student exposure hours (see Table 1). The exposure factor for environmental science classes was developed by multiplying the number of weeks in a school year (35, not including the first and last week of school) by 45 minutes per class by five classes per week. Local fieldtrips were assigned an exposure factor of five hours. Even though a local fieldtrip may only last one or two hours, there is usually a couple hours of classroom discussion or activity associated with it. Distant fieldtrips were similarly assigned an exposure factor of 15. Both environmental clubs and student gardens have exposure factors of 35 based on one hour of

[1] In order to qualify for the free or reduced-price lunch program a student's family has to have an income equal to or less than 185% of the Federal Poverty Level for their household size (USDA 2007).
[2] Schools that the California Department of Education (CDE) defines as "small" or as "ASAM"—alternative schools serving very high-risk student populations (CDE 2006)—were not included in the study.
[3] All classes were titled "environmental science" except for one school which had an "environmental studies" class.
[4] Local fieldtrips are defined as fieldtrips that are within walking distance. Distant fieldtrips are those that are **not** within walking distance.

participation per week in the school year. The environmental student exposure hours data were then divided by the total number of students at the school to get hours per student and tested for correlation with SES using a correlation analysis.

Table 1. Calculation of student environmental education involvement hours.

Env Ed Component	**Exposure Factor**	**# Students**	**Product**
# AP Env Science Classes	130	# Students involved per activity	*= Env Ed Student Exposure Hours*
# College Prep Env Science Classes	130		
# Local Fieldtrips	5		
# Distant Fieldtrips	15		
# Environmental Clubs	35		
# Student Gardens	35		

The second part of the study explored the amount of funding a school allocates for environmental education and the SES of the school's students. Phone and email surveys with principals at each of the high schools determined the amount of money allocated for five aspects of environmental education (i.e. AP Environmental Science Classes, College Prep Environmental Science Classes, Outdoor Fieldtrips[5], Environmental Clubs, and Student Gardens) (see Appendix C for the Principal Survey). In order to include the value of teacher salaries in the calculation of money spent on environmental science classes, the amount of teacher salaries going toward teaching environmental science classes was estimated by multiplying the average teacher salary in the district by the number of environmental science classes offered at a school by 0.2. A factor of 0.2 was used because teachers are responsible for approximately 5 classes a term. The average teacher salaries were compiled from School Accountability Progress Report Cards on the CDE website (CDE 2007). The estimated teacher salary values were added to the totals for money spent on environmental science classes. The amounts spent on the five components were summed and divided by the number of students at each school to get the total money spent by each school on environmental education per student. A correlation analysis was used to check if higher environmental education funding correlates with higher SES.

Lastly, the data on absolute environmental education funding was converted to a relative figure in relation to the total budget of the school by dividing the dollars spent of environmental education by the school's total annual budget. Data on total school budgets were collected by

[5] The distinction between local and distant fieldtrips could not be made in funding surveys because principals generally had only one value for all fieldtrips.

way of phone and email surveys with principals and district financial officers. A correlation analysis was run to see if percentage of budget spent on environmental education increases or decreases with higher SES.

For each of these dependent variables describing the environmental education offered at a school (i.e. hours per student, dollars per student, and percent budget) the percentage of students characterized as SED was used as a measure of the SES of the students. As an additional investigation, correlation analyses were also run using school size (number of students) and a school's API score as explanatory variables against the three environmental education measures in order to see if these variables explain any of the variation in quantity of environmental education offered at public high schools.

Results

This study used the percentage of students at a school who are characterized as SED as a measure of SES of the students at that school. The higher the SED percentage is, the lower the SES characterization of the students at the school. The 19 Contra Costa high schools who returned completed surveys are skewed to the side of lower SED, therefore higher SES (Fig. 1). Of the Contra Costa high schools who returned surveys 24.6% of students are characterized as SED while the percentage for all high schools in California is 43.1% (CDE 2006).

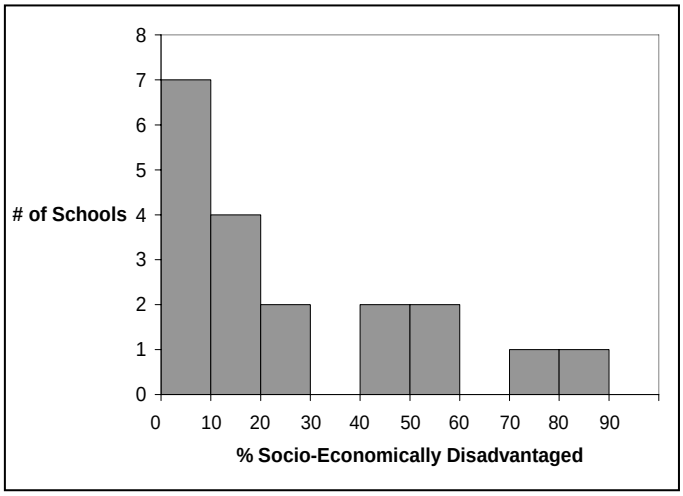

Figure 1. SES distribution of the schools surveyed as represented by percentage of students who are characterized as SED (n=19).

The first investigation of this study explored the potential correlation between the SES of the students at a school and the amount of environmental education experienced by students at that school in terms of exposure hours per student. A correlation analysis between percentage of students characterized as SED and total environmental education hours per student (Fig. 2) did not show a significant relationship (r^2=0.1386, p=0.1281). One outlier was removed from this and the following two analyses because it is a very small charter school specifically serving

diverse, low-income students and the school's science teacher used to work at an outdoor environmental education institute. Regression statistics for all three analyses with the outlier included are reported in Appendix D.

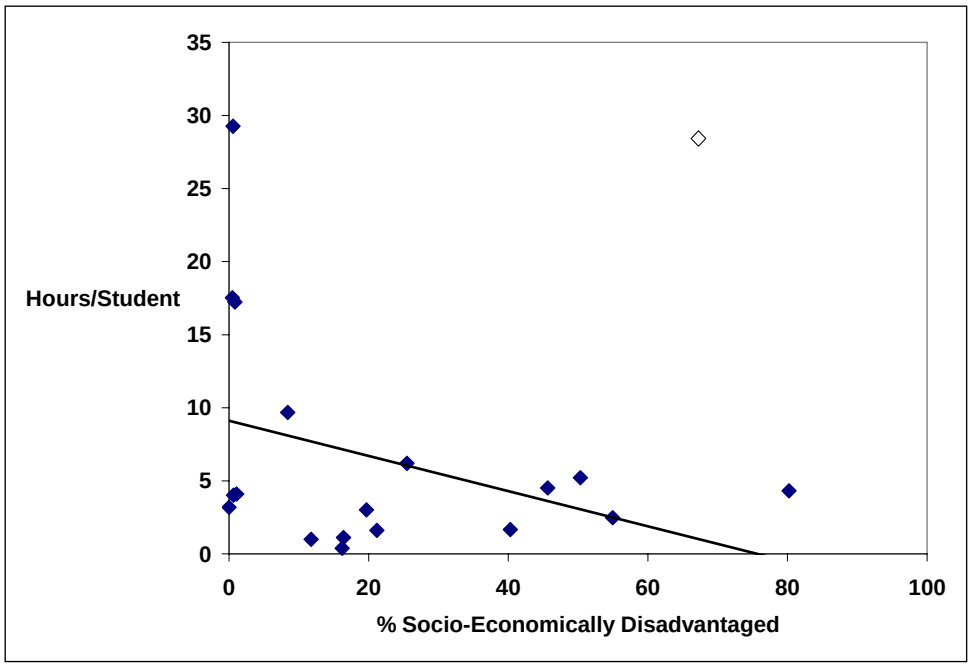

Figure 2. Environmental education hours per student per year as a function of percentage of students characterized as SED. One outlier (the hollow diamond) is not included in the regression. r^2=0.1386, p=0.1281, n=18.

The second part of this study investigated the possible correlation between SES of students at a school and the funding that school allocates for environmental education. Data from principal surveys on environmental education funding were analyzed using a correlation analysis. The analysis showed a significant inverse relationship (r^2=0.3012, p=0.0521) between percentage of students characterized as SED and total environmental education funding in terms of dollars per student (Fig. 3).

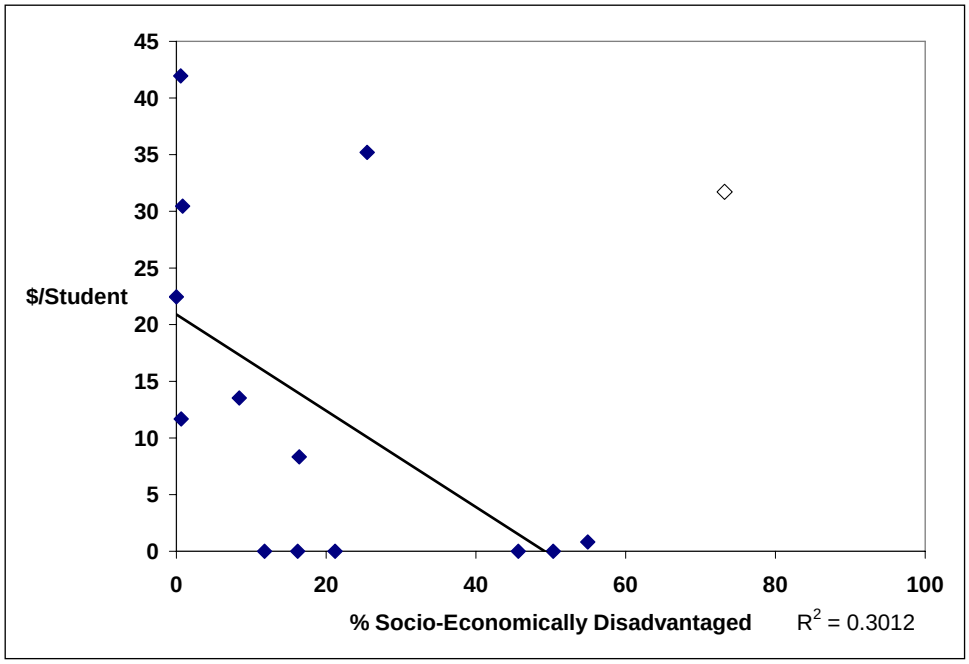

Figure 3. Environmental education dollars per student per year as a function of percentage of students characterized as SED. One outlier (the hollow diamond) is not included in the regression. r^2=0.3012, p=0.0521, n=13.

Dollars spent on environmental education at each school was then divided by the school's total annual budget from principal and financial officer surveys to get the percentage of the school budget spent on environmental education. A correlation analysis did not show a significant correlation (r^2=0.2619, p=0.1305) between percentage of students characterized as SED and percentage of total budget spent on environmental education (Fig. 4).

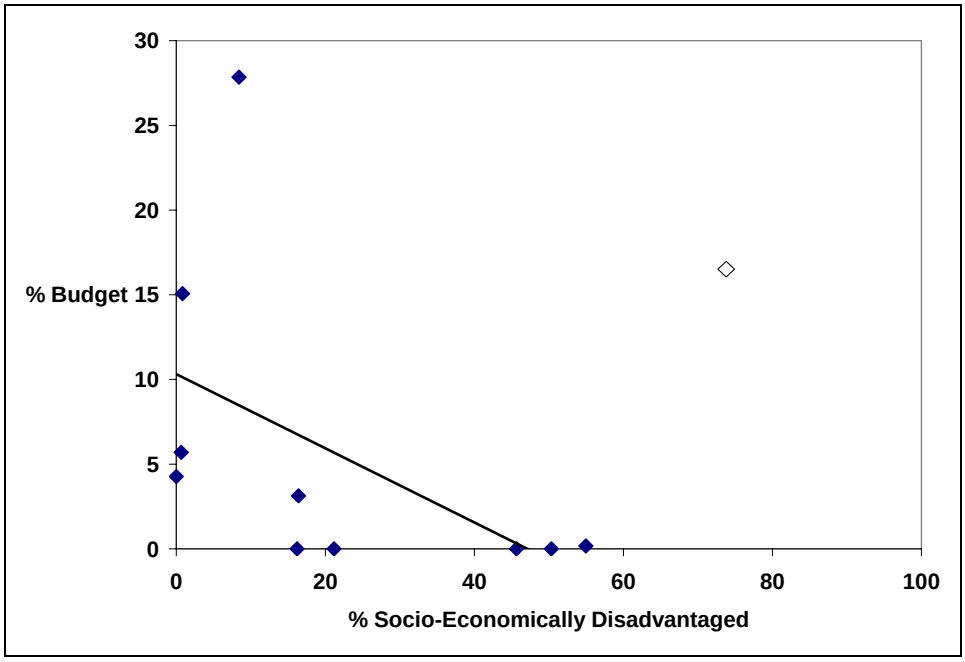

Figure 4. Percent of annual school budget spent on environmental education as a function of percentage of students characterized as SED. One outlier (the hollow diamond) is not included in the regression. r^2=0.2619, p=0.1305, n=10.

In order to compare the time and money spent on the environmental education components by high and low SES schools, a natural break in the distribution of SED was identified with sufficient data points on each side. This natural break occurred at about 40% of students in a school characterized as SED. Low SES schools were then defined as those with more than 40% of their students characterized as SED and high SES schools as those with less than 40%. While high SES schools provided approximately the same amount of environmental education hours per student as low SES schools, high SES schools spent 4.5 times more dollars per student on that environmental education (Fig. 5).

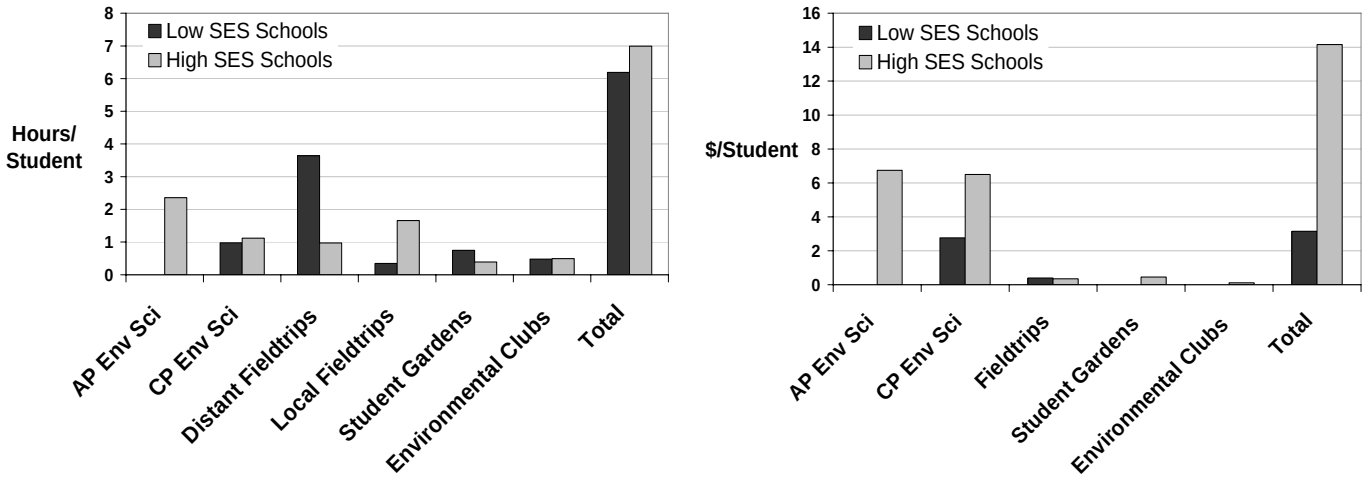

Figure 5. Total environmental education hours (left) and dollars (right) per student per year for each category of environmental education. Comparison of low SES schools (those with more than 40% of their students characterized as SED, n=4) and high SES schools (those with less than 40% of their students characterized as SED, n=10).

To explore other possible explanatory variables, school size (number of students) and 2006 API test scores were tested for correlation against the three dependent environmental education variables. Of the six analyses conducted only one significant correlation was found (r^2=0.2970, p=0.0194). As a school's API score increases, so do the environmental education hours that school provides per student (Fig. 6). The school that was removed as an outlier from the three previous correlation analyses was removed from this analysis for the same reason (see Appendix D for the regression statistics when outlier is included).

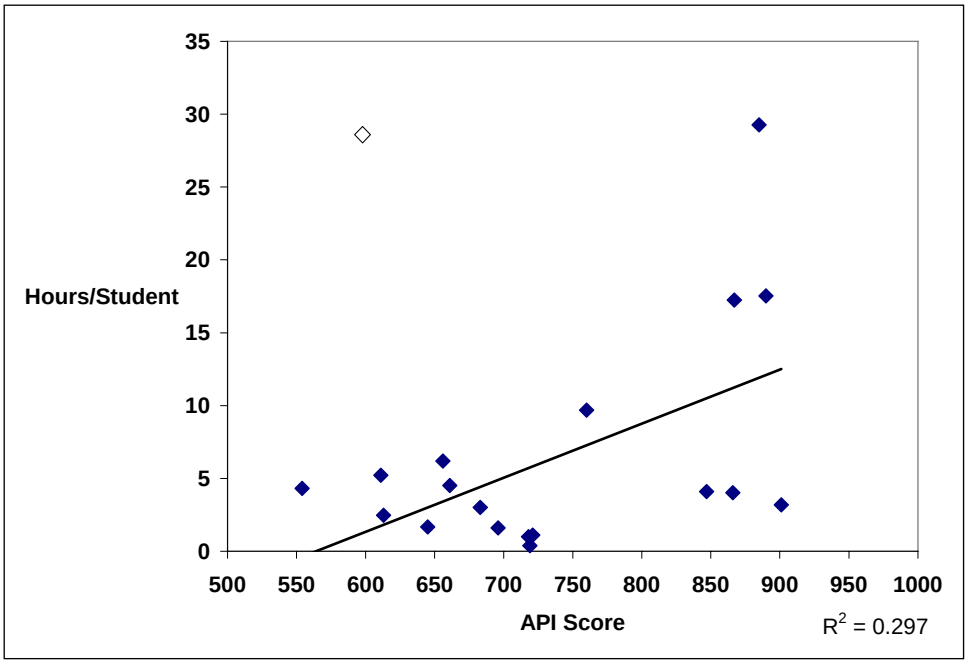

Figure 6. Environmental education hours per student as a function of API score. On outlier (the hollow diamond) is not included in the regression. r^2=0.2970, p=0.0194 n=18.

Discussion

This investigation of unequal opportunity in environmental education showed only one significant correlation: as the percentage of SED students at a school increases, the amount of money spent on environmental education per student decreases. Significant correlations were not found for the other two relationships: environmental education hours by SED and percent budget spent on environmental education by SED.

Although there was no significant relationship between percentage of students characterized as SED and total environmental education hours per student, environmental education hours per student did decrease with increasing SED. In this study it appears that there could be a positive relationship between amount of environmental education offered and SES as hypothesized. This result cannot be inferred strongly though because it is only a weak observed correlation and because of sources of error in this study's methodology. A source of error for this first investigation in particular was the exposure factor estimations. It is hard to know the amount of time that is actually utilized in a 50 minute long environmental science class and whether the exposure factor should include an estimation for time spent on homework. Furthermore, in the real world time spent on local and distant fieldtrips is highly variable from one trip to another and the time spent in a garden or club may be different for each student involved. A possible source of error for all of the investigations was the definition of environmental education used. With concepts of environmental education continually changing and generally vague it is difficult to determine which activities and programs should be considered environmental education. For example, should a marine science class be considered environmental education? For some it would most definitely be included as environmental education but for this study it was not.

The second investigation found a significant correlation between SED and dollars spent on environmental education per student. My hypothesis that dollars spent on environmental education per student increases as SES of students at a school increases was supported. This was probably the most logical of the three hypotheses. As SES of students at a school increases the school generally has better funding, therefore higher SES schools can put more dollars toward environmental education because they have more money to begin with than lower SES schools.

Curiously the relative analysis of funding—percent budget spent on environmental education—did not show statistically significant results although percent budget spent on

environmental education did generally decrease with increasing SED. The lack of significance of my third hypothesis is quite possibly due to difficulties in determining annual school budgets. Budgets are dealt with differently from district to district and school to school. "Site discretionary" budgets are the unrestricted funds which a school has the discretion to assign where the principal or financial manager sees fit. Some schools reported not having any site discretionary budgets while others included encumbered funds such as School Improvement Grants. This inconsistency of reported budget values makes it difficult to accurately compare and analyze budget data. Another source of error for the second and third investigations was the inconsistency of reported funding values for environmental science classes. Some principals reported values for textbooks and classroom materials, others reported a value that did not have explanation and some omitted a response to this question altogether. None of the responses included a value for the teacher's salary. For these reasons the budget spent to pay environmental science teachers was estimated and included as funding toward environmental science classes. This methodology provided for results that were more representative of the resources allocated for environmental science classes.

The comparison of time and money spent on the environmental education components by high and low SES schools showed a trend that low SES schools are funding environmental education 4.5 times less than high SES schools while providing nearly the same amount of environmental education hours. Most of the environmental education funding went toward environmental science classes and since high SES schools had three times the environmental science classes as low SES schools the trend in funding makes sense. The additional variation may be due to the fact that high SES schools pay their teachers higher salaries. In any case, low SES schools must be providing environmental education that is cheap or free for the school. More than half the environmental education hours for low SES schools were from distant fieldtrips which are either paid by students or outside grants. If they are paid by students there could be concern for unequal opportunity in environmental education *within* the school as low SES students may not be able to afford the fieldtrip opportunities at their school.

The additional investigations of school size and API score as explanatory variables against the three dependent environmental education variables resulted in one significant correlation. As a school's API score increases, the environmental education hours that school provides per student also increases. A likely reason for this result is that schools with low API scores are

under a great amount of pressure to teach and increase scores for standardized test subjects like math and English and do not have as much time to invest in environmental education as schools with higher API scores.

The insignificance of two of my hypotheses, the significant API result, and the effect of the outlier all indicate that there are factors affecting environmental education offerings and funding at public high schools other than the SES of the students at the school. As explained in the results section, one school was removed from all the correlation analyses as an outlier. This school was identified as an outlier due to the presence of one teacher who had a strong background in environmental education and therefore was motivated to drive the environmental education components at his school. The fact that removing this school as an outlier changed one correlation analysis from insignificant to significant suggests that motivation, background, and experience of individual faculty members are other variables determining a school's environmental education offerings. As supported by the correlation analysis of API score by environmental education hours, standardized test score and stress also affect the amount of environmental education at a school. Another explanatory variable is evident by the fact that about three teachers/science chairs reported that their school offered an environmental science class but not enough students enrolled to have a class this year. Apparently student interest is a factor that determines the amount of environmental education at public high schools.

This study supports the hypothesis that high SES schools spend more money per student on environmental education than low SES schools. However, results also suggest that while low SES schools are spending much less money than high SES schools on environmental education, they provide comparable amounts of environmental education hours. Further investigation should assess if the quality of environmental education suffers at low SES schools due to lesser funding. Additionally, since there is evidence that students at low SES schools are left responsible for funding much of the environmental education at their school, the possibility of unequal environmental education opportunities among students within schools should be considered. Another interesting result of this project was the identification of variables that affect the amount of environmental education programs and funding at public high schools in addition, and possibly even more so, than SES (i.e. API score, teacher motivation and experience, and student interest). While this case study shows that there is indeed concern for unequal opportunity in environmental education in terms of funding, there is not a concern in

terms of hours offered. Through student funding and teacher motivation lower SES schools manage to provide environmental education opportunities despite their lack of funds.

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Appendix A: Contra Costa Public High Schools in Study

Acalanes Union High (District)
Acalanes High
Campolindo High
Las Lomas High
Miramonte High
Antioch Unified
Antioch High
Deer Valley High
John Swett Unified
John Swett High
Liberty Union High
Freedom High
Heritage High
Liberty High
Mt. Diablo Unified
Clayton Valley High
College Park High
Concord High
Mt. Diablo High
Northgate High
Ygnacio Valley High
Pittsburg Unified
Pittsburg Senior High
San Ramon Valley Unified
California High
Monte Vista High
San Ramon Valley High
West Contra Costa Unified
De Anza Senior High
El Cerrito Senior High
Hercules High
Kennedy High
Leadership Public School
Pinole Valley High
Richmond High

Appendix B: Teacher/Science Chair Survey

1. How many AP Environmental Science classes does your school offer and how many students are enrolled in each class this term?

2. How many college prep Environmental Science/Studies classes does your school offer and how many students are enrolled in each class this term?

3. How many local outdoor fieldtrips (ones that are within walking distance) does your school conduct per year and about how many students participate?

4. How many distant outdoor fieldtrips (ones that are **not** within walking distance) does your school conduct per year and about how many students participate?

5. Does your school have an environmental student club or academy and about how many

students are involved?

6. And lastly, does your school have a student garden and about how many students are involved?

Appendix C: Principal Survey

1. What is your school's annual budget (the Site Discretionary Budget)?
2. Does any money from the school budget go toward AP Environmental Science classes? Approximately how much?
3. How much money goes toward college prep Environmental Science or Studies classes?
4. Toward outdoor fieldtrips?
5. Toward environmental student clubs or academies?
6. Toward student garden(s)?

Appendix D: Regression Statistics With and Without Outlier

Dependent Variable	**Explanatory Variable**	*With Outlier*		*Without Outlier*		**Correlation**
		r^2	**p**	**r^2**	**p**	
Hours/Student	% SED	9.33E-5	0.9687	0.1386	0.1281	Not significant
$/Student	% SED	0.0447	0.4678	**0.3012**	**0.0521**	**Significant: Negative**
% Budget	% SED	0.0279	0.6235	0.2619	0.1305	Not significant
Hours/Student	API Score	0.0629	0.3005	**0.2970**	**0.0194**	**Significant: Positive**