Impact of Advanced Placement Environmental Science on Environmental Beliefs and Actions of High School Students in Freehold Township High School, NJ

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Abstract

This study aimed to investigate the effects of Advanced Placement Environmental Science on the pro-environmental behaviors and beliefs in high school juniors and seniors at a high school in central New Jersey. Using a pro-environmental behaviors scale adapted from earlier research by Astrid Leeuw (2015) in conjunction with the theory of planned behavior, students were asked to complete binary survey questions designed to determine if they engaged in certain pro-environmental behaviors and scaled questions to determine environmental beliefs. A pilot study was created in the 2018/2019 school year in which students took the survey at the end of the school year to determine survey effectiveness and establish baseline results. In 2019/2020 a new group of high school students in the same school took pre- and post-surveys that were informed by the pilot study to investigate how Advanced Placement Environmental Science informed their pro-environmental behaviors and beliefs. The pre-survey was distributed in class in January 2020, and the post-survey was distributed during distance learning in April 2020 due to the COVID-19 pandemic. Potential ramifications of the change in distribution methods are explored in the paper. Statistical analyses were performed on the data collected. The effectiveness of Advanced Placement Environmental Science on pro-environmental behaviors and beliefs remains an ongoing question. There was no difference in the responses in the pre- and post-survey. Where statistically significant differences did exist, delays in IRB approval and local Board of Education approval combined with the change in pre- and post-survey distribution methods makes establishing a direct paired comparison difficult. Consistency in survey responses between the 2018/2019 and 2019/2020 cohorts was established. Potential avenues of future research are explored.

Introduction

The state of the environment is one of the most important issues facing humanity. Humans are rapidly changing the natural world. Deforestation is accelerating and species are going extinct at alarming rates (Lindsey 2013). Climate change is an ever-present threat with solutions that still seem distant, requiring both technological innovations that have not yet been invented and changes in consumption, such as reducing fossil fuel use towards more sustainable alternatives (Metcalf 2019). In the midst of all this environmental destruction lies the ever-present question of how we, as a society, begin to change these outcomes. Certainly, it can be argued that younger generations will be the ones to inherit these problems, and they also will have the responsibility of creating solutions to these problems. To that end, it is imperative that current students not only have exposure to the depths of these problems but see that their actions can have an impact on the world around them. One way to achieve this goal is to ensure students have access to courses in environmental education.

Environmental education has been an increasingly important topic in today's world. According to the North American Association for Environmental Education, environmental education is "is a process that helps individuals, communities, and organizations learn more about the environment, and develop skills and understanding about how to address global challenges." (NAAEE.org 2017) Offered in both the elementary and secondary classrooms in some school districts across the United States, environmental education is at the forefront of timely issues such as climate change, ocean acidification, and carbon sequestration. It is a relatively new standalone course offering in the high school setting. Previously, the typical track for a high school student was to take a combination of biology, chemistry, earth science, and physics.

However, as important a role as each of those courses play, a new course that combined many of the concepts in those four other classes was needed to provide a big picture overview of the relationships between Earth's systems and the impact of human activity on our planet. Unfortunately, the increasing standardization of curriculum across the United States since the No Child Left Behind Act (NCLB) of 2002 has focused primarily on math and reading. "Unfortunately" is used not because they are not important aspects of education - they most certainly are. However, there is a finite amount of time within a school day. Any increased focus in some areas will necessitate a decrease in other areas. In addition, this standardization has brought with it a focus on test-taking strategies and memorization techniques (Oxford 2012) at the expense of problem-solving techniques and perseverance.

The pendulum has begun to swing back a little with the completion of the Next Generation Science Standards (NGSS) in 2013. The NGSS has begun a re-emphasis on problem-solving through the incorporation of engineering and design standards that are woven into the curricula. For example, one standard in the NGSS states students must "evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that count for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts." (NGSS, n.d.) Students are expected to engage in work that is driven by questions that arise in an engineering design problem (National Research Council 2015). Schools in 44 states, including the state of New Jersey, have been re-writing their curricula in accordance with these new standards (NSTA 2020). Though some states, including Texas, have not adopted the NGSS or standards based on them, the majority of students in the US are being taught with curricula influenced by the NGSS.

Even prior to the NGSS and NCLB, some individual schools developed curricula to establish environmental science courses to fill this gap created by the traditional biology, chemistry, and physics course map. These courses only include snippets of environmental education in single units (FRHSD n.d.) and do not focus on the interconnectedness of earths' systems that is central to APES. Getting in front of this trend was the College Board, which launched Advanced Placement Environmental Science in 1998. The College Board is a not-for-profit organization that works to prepare students for a successful transition to college (College Board 2019). The College Board is the organization that developed the SAT, as well as Advanced Placement courses for high school students. Advanced Placement courses are designed to engage students in college-level work while in high school, with the incentive that if students take the Advanced Placement exam in May for a given AP course, they can earn college credit for that course. AP tests are scored on a scale of 1-5. Students who score a 4 or a 5 on an exam will typically receive college credit for that course. In 1998, the first Advanced Placement Environmental Science (APES) test was administered to high school students by the College Board. In 2008, 61,380 students had taken the exam. By 2018, 166,433 students sat for the exam (College Board 2018). In the span of a decade the number of students taking the exam nearly tripled. How much of this increase can be attributed to the adoption of the NGSS is unknown, but its emphasis on problem-solving and perseverance lends itself well to the study of environmental science.

With the expansion of environmental science offerings, we can begin to study the impact of this course on students. Pro-environmental behaviors have been defined as "behavior that consciously seeks to minimize the negative impact of one's actions on the natural and built

world" (Kollmuss 2002). Beyond the acquisition of new knowledge, a question remains as to the impact of environmental science on the worldviews of the high school students taking this course. What role does an environmental science curriculum have, if any, in shaping the next generation of Americans and their opinion of the importance of environmental issues? In addition, environmental education should not just inform viewpoints, but should also serve to affect pro-environmental behaviors (Shobeiri 2007).

There has been some research into this topic. For example, researchers surveyed college students at the University of Bucharest, focusing on pro-environmental consumer behavior and lifestyle patterns. They observed a disconnect between what the students reported in terms of environmental awareness compared to their actual actions as it related to pro-environmental behaviors (Szerényi 2009). Another study of middle school students in Turkey determined that environmental awareness correlates to positive environmental attitudes, and that positive environmental attitudes in turn increase the likelihood of pro-environmental behaviors (Ari 2017). In England, a study of college students found that a barrier to students engaging in recycling was both a lack of recycling facilities and a lack of environmental awareness (Abdullah 2019). A common theme throughout these studies appears to be that environmental education can play a significant role in creating actionable pro-environmental behaviors in students and young adults. A lack of environmental awareness seems to correlate to some extent to less environmentally sustainable behaviors. Of course, environmental education is not a panacea, but it does appear to be a foundation upon which a more sustainable future can be built. The purpose of this capstone project is to explore the impacts of environmental science education on the pro-environmental behaviors and beliefs of high school students

through surveys of students in a New Jersey high school Advanced Placement Environmental Science course. These are students in my class, as I am an APES teacher. I have been teaching APES for nearly a decade, having started the APES program at my NJ school. The first year there were sixteen students in one section. Within two years, there were over one hundred students in four sections. I have been part of the APES curriculum writing committee in my district as well. The APES course consists of nine units, including: The Living World: Ecosystems, The Living World: Biodiversity, Populations, Earth Systems and Resources, Land and Water Use, Energy Resources and Consumption, Atmospheric Pollution, Aquatic and Terrestrial Pollution, and Global Change (College Board 2020).

The surveys were created based in part on the of planned behavior (TPB). TBP, first described by Icek Azjen in 1985, posits that individuals weigh the expected outcomes of behaviors with the evaluation of the benefits and risks associated with that outcome when engaging in a particular behavior (Azjen 1985). This theory has been successfully applied to many areas of personal behavior. It involves several constructs, including subjective norms (do peers believe the individual should engage in the behavior?) and social norms (are these behaviors customary in the larger social group the individual is part of?). Another important factor is behavioral intention, which states that the stronger the intention to perform the behavior, the more likely the individual is to engage in the behavior.

According to research, high school students tend to adopt positive attitudes towards environmentally sustainable behaviors when they believe these behaviors produce favorable outcomes (Leeuw 2015). In addition, background factors such as gender and socioeconomic

status can possibly impact personal beliefs (Fishbein 2011), which in turn can impact willingness to adopt pro-environmental behaviors. While this study will not explore all of these potential impacts to survey outcomes, it is important to recognize that these are potentially influential factors when studying pro-environmental behaviors in high school students. They can also be used to further future research, and this will be discussed later in this paper.

A pilot study was created that was used to inform a pre- and post-survey of APES students. These surveys were used to investigate the self-reported pro-environmental behaviors of these students before and after completing a course in APES. In addition, results from the post-survey were compared to the results from the pilot study to determine overall consistency of responses. Findings from this study can help to inform the pro-environmental behaviors of APES students and investigate the effectiveness of environmental education in developing and establishing these behaviors.

Methods

Sample Population

The Environmental Ethics Scale was conducted at Freehold Township High School (FTHS), located in Monmouth County, New Jersey. It is an upper-middle class suburb of New York and Philadelphia. Freehold Township is approximately 38.7 square miles with a population of 35,429 as of 2017 (U.S.Census 2017). It has a median household income of $99,827 and 6.4% of the population lives below the poverty line. In comparison, New Jersey in the aggregate has a poverty rate of 10.7%. Nationally, the median household income in the United States is $60,336 (Guzman 2017). Approximately 95% of adults have a high school diploma in

Freehold Township, and 46.6% have a bachelor's degree or higher. The median value of a home in Freehold Township is approximately $410,000 (U.S. Census 2017). Taken together, Freehold Township is a moderately wealthy suburb of NJ, with an income level significantly above the national average.

Freehold Township High School is one of six high schools that combine to form the Freehold Regional High School District (FRHSD), which is the largest high school only district in the state. FRHSD consists only of high schools in the central part of New Jersey. The towns that send their students to the high schools in the FRHSD include Freehold Township, Freehold Borough, Marlboro, Manalapan, Englishtown, Howell, Colts Neck, and Farmingdale. Kindergarten through 8th grade is run by the individual towns that comprise the FRHSD and are separate systems. Freehold Township High School has 2,013 students enrolled in grades 9-12. The total minority enrollment is 24% with 10% being economically disadvantaged, determined by receiving free or reduced lunch (U.S. News n.d.). The cohort tested in this project were Advanced Placement Environmental Science (APES) students. These students are enrolled in a public secondary school and are upperclassmen. APES is not a required class for graduation. It is an Advanced Placement elective but counts towards the 3 years of science requirement mandated by the State of New Jersey for graduation (NJDOE n.d.). The vast majority of students are not going into environmental science as post-secondary study.

Pilot Study

In the 2018 - 2019 school year, a pilot study was developed and run with APES students in Freehold Township High School. This pilot study was conducted to test the survey questions and ensure their clarity to the high school population. In this cohort, there were 106 students tested of which 58% were female and 42% were male. Ages ranged from 16 to 18 years old. Class breakdown includes 67% seniors and 33% juniors in four separate sections. A total of 106 students were asked to access the Environmental survey via a link on their Google Classroom site on May 21st, 2019. Each section of the course has their own Google Classroom section. A Google Form was used to create the survey itself. The link to the Google Form was posted to Google Classroom as students arrived in class to avoid students pre-discussing the questions. The survey was restricted to users with a Freehold Regional High School district email account. Students used their cell phones to access and respond to the survey. There were no time limits to the survey, but each student could only submit the survey once. Students were instructed not to talk while taking the survey. As surveys were collected, the system automatically timestamped responses with the date and time of submission. Students were instructed not to discuss questions with students in other sections who have not taken the survey yet, so as not to influence responses. In the pilot study, no alternative activity was offered to students who did not choose to participate. Because no alternative activity was offered, students who did not participate would be able to be identified by other students in the classroom. The results were not anonymous, since the Google Form was set to collect student email addresses.

The pilot questionnaire administered to the 106 Advanced Placement students consisted of twenty-five questions. The first thirteen questions were binary questions, answers to which

were "Yes" or "No". These binary questions were initially used as an instrument for Pro-environmental behaviors scale in the study by A. de Leeuw, et al in the *Journal of Environmental Psychology* (Leeuw 2015)*.* These questions were designed to determine the behaviors of the cohort with regards to specific action items. The remaining twelve questions were rated on a 5-point scale; ten questions ranging from "strongly agree" to "strongly disagree," and the other two ranging from "never" to "very often." Both scales contained "neutral" as a possible response. Neutral was taken to imply "no opinion" from the respondent. The scaled questions were included to indicate the environmental ethics of the high school student. Unlike the binary questions, these were not modified from a previous study. Instead, they were designed through an iterative process during the practicum course for the pilot study. These questions inquired about the students' awareness of the environment and their perceptions surrounding the current state of environmental issues. The scaled questions also were added to gauge the feeling of whether individual impact had an influence on the greater good. Question 21 in Figure 1 challenges if the APES student was able to understand the "interconnectedness" of the world, which is the concept that nothing lives alone and relies on the abiotic, non-living, and biotic, living, components to thrive. This is a theme that runs throughout the AP Environmental Science curriculum as the students explore the many topics throughout the class both theoretically and hands-on in projects and labs.

Questions 19, 20 and 23, also in Figure 1, are acknowledging the awareness of the world around the student. The idea of "seeing" nature in everyday situations is an important concept. The thought being that if you see and understand the world around you and partake in projects pertaining to the environment in a class, you develop an appreciation for it, which would lend

itself to the idea of protection or stewardship (Fischer 2000). Students that consider themselves "environmental stewards," are those who have a responsibility through conservation, recycling and restoration. These ideas would be portrayed in everyday life as using reusable bags, reusable water bottles, participating in beach clean-ups, etc. These questions correlate with a specific idea that the student has an ecological awareness that was augmented throughout the year after being exposed to the various topics within the APES curriculum. The last questions, 24 and 25, ask about the frequency of watching the news for both the student and the parent. These questions would seek to inform any correlations between the environmental beliefs and behaviors of students with their visual news consumption. In addition, research could determine if students with parents who watch the news are more likely to watch the news themselves. Figure 1 below displays the questions asked in the pilot survey.

Figure 1 - Questions Administered on Pilot Survey

Pro-environmental behaviors scale
       (#1-13) yes/no

1.   I leave the water running while I brush my teeth
2.   I forget to turn off the light when I leave my room
3.   I leave the fridge door open while I think about what I'm going to eat
4.   At home, I put trash in the proper recycling bin
5.   I use both sides of a piece of paper when I write or print a document
6.   At school, I put my trash in the proper recycling bin
7.   I leave the TV on while I'm doing other things in the house
8.   I turn off the TV or the video game when I'm done
9.   I often shower for more than 20 min
10.   When I'm outside, I avoid littering
11.   When I'm cold, I put on a sweater instead of turning up the heat
12.   I read documents or books about environmental or animal protection

13.   I consume organic produce

Scaled Questions
       (#14-23) strongly disagree, disagree, neutral, agree, strongly agree
       (#24-25) never, rarely, sometimes, often, very often

14.   Climate change is a serious problem facing our planet
15.   Climate change is a political issue
16.   I am aware of current environmental issues
17.   I am concerned about the current environmental state of our planet
18.   My individual actions have an impact to influence the greater good of our planet
19.   I am more environmentally conscious after taking AP Environmental Science,than before completing this class.
20.   After taking AP Environmental Science, your actions are more environmentally conscious than before completing this class.
21.   The planet has a high level of interconnectedness
22.   The United States is environmentally responsible
23.   You are a steward of the environment
24.   How often do you yourself watch the news
25.   How often do your parents watch the news

Paired Study

This paired, capstone study builds off information learned from the pilot study. Like the pilot study, the capstone study consists of juniors and seniors from Freehold Township High School in Freehold Township, New Jersey who are enrolled in Advanced Placement Environmental Science during the 2019-2020 school year. Unlike the pilot study, which consisted of questionnaires distributed to students once after the completion of all course material (and after the Advanced Placement exam was given by the College Board), the capstone study consisted of a questionnaire distributed twice to students.

It should be noted that the capstone study required Institutional Review Board (IRB) approval since study participants were students that could be under the age of 18 years old. As such, survey questions and the method of distribution were reviewed prior to students taking the pre- and post-surveys. In addition, once IRB approval was granted, the Freehold Regional High School District Board of Education had to grant approval for students to take the survey. This process ultimately took several months, and when final approval by the Board of Education was granted, January 24th, 2020 was the first day it was possible to distribute the pre-survey to students. As a result, students already had several months of instruction in APES topics. The impact of this will be explored in the results section.

The first capstone questionnaire was given to students on January 24th, 2020. At that time, students were still in the process of learning content from the course. The class began in early September 2019. The same questionnaire was given again to students several months later, on April 8th, 2020. By giving a pre-survey and post-survey, impacts of APES on environmental worldviews and ethics can be analyzed.

The survey given to the capstone cohort was similar to the pilot study but did contain clarifying statements in several questions that did not appear in the pilot survey. Two questions were replaced entirely, and a question about gender was added. Slight changes include changing the word "my" to "the" in question 2, eliminating the word "my" from question 6, and eliminating the word "environmental" from question 17. Questions 19 and 20 are both new to the capstone survey and did not appear on the pilot survey. In question 21, a clarifying statement providing the definition of interconnectedness ("the interdependency between the abiotic and biotic

features on earth") was included. In question 23, a clarifying statement providing the definition of environmental steward ("Stewardship refers to the responsibility to protect the environment through recycling, conservation, and restoration") was included. These clarifying statements were included based on feedback from students in the pilot study. There was confusion around the meaning of the terms "interconnectedness" and "environmental steward" from many students. In order to ensure that students who took part in the capstone study could confidently answer these questions, these clarifying statements were included. Figure 2 below shows the questions asked in the capstone study.

Figure 2 - Questions Administered on Capstone Study Pre- and Post-Surveys

Gender (Male, Female, Prefer not to answer)

Pro-environmental behaviors scale
(#1-13) yes/no

1. I leave the water running while I brush my teeth
2. I forget to turn off the light when I leave the room
3. At home, I put trash in the proper recycling bins
4. I use both sides of a piece of paper when I write or print a document
5. At school, I put trash in the proper recycling bin
6. I leave the TV on while I'm doing other things in the house
7. I leave the refrigerator door open while I think about what I'm going to eat
8. I turn off the TV or the video game when I'm done
9. I often shower for more than 20 minutes
10. When I'm outside, I avoid littering
11. When I'm cold, I put on a sweater instead of turning up the heat
12. I read documents or books about environmental or animal protection
13. I consume organic produce

Scaled Questions
(#14-23) strongly disagree, disagree, neutral, agree, strongly agree
(#24-25) never, rarely, sometimes, often, very often

14. Climate change is a serious problem facing our planet
15. Climate change is a political issue
16. I am aware of current environmental issues
17. I am concerned about the current state of our planet
18. My individual actions have an impact to influence the greater good of our planet
19. I notice the natural world around me (trees, flora, fauna, etc…)
20. My actions are eco-friendly (recycle, use reusable water bottles, use reusable bags, attempt to use less plastic, etc…)
21. The planet has a high level of interconnectedness (the interdependency between the abiotic and biotic features on earth)
22. The United States is environmentally responsible
23. I am an environmental steward (Stewardship refers to the responsibility to protect the environment through recycling, conservation, and restoration)
24. How often do you yourself watch the news
25. How often do your parents watch the news

The capstone survey differed from the pilot study in several other ways as well. First, the surveys were collected anonymously. No identifying information from any survey participant was captured, other than gender. Given that 97 students took the pre-survey and 60 students took the post-survey, gender alone cannot identify any individual participant. In addition, the pre- and post-surveys were taken using Qualtrics software hosted through Oregon State University. The questions were entered into Qualtrics and students used a link posted in their Google Classroom to access the surveys. Students were advised in the directions section of the survey that participation in the survey is optional. Before proceeding into the survey itself, students were required to click "I Agree" after reading the consent form and agreeing to participate. For students who chose not to participate, they clicked "I Do Not Agree" and were taken instead to an alternative activity that involved reading an online article related to an environmental topic previously covered in class. The article was chosen based on its relevance

to topics previously covered in class along with the length of the article. Those who read the article would spend approximately the same amount of time reading the article as they would taking the survey. In this way, students who chose to read the online article would not be identifiable and would remain anonymous. In the pilot study, there was no alternative activity for students to participate in if they chose not to take the survey.

Results

Pilot Study

In the pilot study, a total of 106 students out of 119 took the survey. There was no identifying information collected in this survey, such as gender, so there is no demographic information to report for this specific group, other than they were junior and senior students at Freehold Township High School in New Jersey. We cannot assume the socio-economic background of this group matches that of Freehold Township provided earlier because this is not a random sample of students drawn from the entire population of the high school. The results from the binary questions in the pilot study can be seen in table 1.

A total of 96% of students report that they do not litter when they are outside (Table 1). This is an extremely high number, and as such it is possible that they came into their environmental science course already having this attitude in place. The litter question had the highest percentage of "yes" responses of all questions asked. Right behind that was the 91% who responded "Yes" to turning off the TV or video game when finished. Only 18% responded "Yes" to reading documents or books about environmental or animal protection. This was the lowest percentage of "Yes" responses of all of the binary questions.

Table 1 - Percentages of Yes/No Responses for Binary Questions		
Question	Yes	No
I leave the water running while I brush my teeth	27%	73%
I forget to turn off the light when I leave the room	30%	70%
At home, I put trash in the proper recycling bin	66%	34%
I use both sides of a piece of paper when I write or print a document	58%	42%
At school, I put trash in the proper recycling bin	75%	25%
I leave the TV on while I'm doing other things in the house	57%	43%
I leave the fridge door open while I think about what I am going to eat	59%	41%
I turn off the TV or the video game when I'm done.	91%	9%
I often shower for more than 20 minutes	43%	57%
When I'm outside, I avoid littering	96%	4%
When I'm cold, I put on a sweater instead of turning up the heat	84%	16%
I read documents or books about environmental or animal protection	18%	82%
I consume organic produce	52%	48%

Table 2* - Average Score Response on a 1-5 Scale		
1 = Strongly Disagree, 5 = Strongly Agree		
Statement	Average	Standard Deviation
Climate change is a serious problem facing our planet.	4.61	0.67
Climate change is a political issue	3.48	1.21
I am aware of current environmental issues	4.05	0.91
I am concerned about the current environmental state of our planet	4.46	0.76
MY individual actions have an impact to influence the greater good of our planet	3.88	0.95
I am more aware of the environment after taking AP Environmental Science (notice trees, flora, fauna, sky, etc...)	4.45	0.74
After taking AP Environmental Science, MY actions are more eco-friendly than before completing this class. (recycle, use reusable water bottles, use reusable bags, attempt to use less plastic, etc.)	3.89	1.02
The planet has a high level of interconnectedness (the interdependency between the abiotic and biotic features on earth)	4.21	0.87
The United States is environmentally responsible	3.2	1.26
I am an environmental steward. (Stewardship refers to the responsibility to protect the environment through recycling, conservation and restoration)	3.5	1.06

Table 3* - Average Score Response on a 1-5 Scale		
1 = Never, 5 = Very Often		
Question	Average	Standard Deviation
How often do you yourself watch the news?	2.88	1.2
How often do your parents watch the news?	4	1.1

*See Appendix A for bar graph outputs from Google Forms for questions reported in Table 2 and Table 3

The vast majority of students (70%) responded that they "strongly agree" that climate change is a serious problem, and 61.3% "strongly agree" that they are concerned about the current environmental state of our planet (Table 2). Only one individual disagreed that climate change is a serious issue, and one individual disagreed with being concerned about the current environmental state of our planet. A total of 86.8% of students either "agree" or "strongly agree" that they are more aware of the environment after having taken AP Environmental Science. The majority (70.8%) of students report that their actions are more eco-friendly now than they were prior to taking AP Environmental Science. Interestingly, the question with the lowest overall average score ($\bar{X}$ = 3.2) was if students believed the United States is environmentally responsible. It also had the largest standard deviation (SD = 1.26) of all the questions, which means it had the greatest variability in terms of responses. The next closest

question in terms of standard deviation was whether climate change is a political issue (SD = 1.21). This is not surprising given the polarizing nature of the topic politically.

In terms of which group watches the news more, the students or their parents, the parents have a significantly higher score ($\bar{X}$ - 4) than the students ($\bar{X}$ = 2.88) (Table 3). Interestingly, however, their standard deviations are nearly identical (SD = 1.1 for parents, SD = 1.2 for students).

Paired Study

As discussed previously, the pre-survey and post-survey used similar questions to the pilot study, with a few modifications. The pre-survey was administered in class, and a total of 89 students answered the questions in the survey. Of those students, 46 were male, 42 were female, and one respondent chose not to answer. However, the post-survey was administered during remote learning due to the coronavirus pandemic. In this setting, only 63 students answered the questions in the survey, despite having the same number of overall students being given the link to the survey. In addition, of the students who responded, 28 were male and 35 were female. This represents a substantial change in the overall proportion of respondents. In the pre-survey approximately 47% of respondents were female and 52% were male, while in the post-survey 56% of respondents were female and 44% were male. The drop in the number of overall respondents has potential implications to the reliability of the results that will be discussed later in the paper. Also, three students in the pre-survey selected "I Do Not Agree" to participate in the research survey whereas no student in the post-survey chose "I Do Not Agree". Given that students were in a distance learning environment, it is possible that

those who did not choose to participate simply did not click on the link in the first place. Students who did choose to take the surveys began, like in the pilot study, with the binary yes/no questions. The results of the binary questions in the pre-survey and post-survey are given in table 4.

Table 4 - Percentages of Yes/No Responses for Binary Questions				
	Pre-Survey		Post-Survey	
Question	Yes	No	Yes	No
I leave the water running while I brush my teeth	26%	74%	16%	84%
I forget to turn off the light when I leave the room	43%	57%	35%	65%
At home, I put trash in the proper recycling bins	76%	24%	83%	17%
I use both sides of a piece of paper when I write or print a document	67%	33%	65%	35%
At school, I put trash in the proper recycling bin	80%	20%	84%	16%
I leave the TV on while I'm doing other things in the house	69%	31%	65%	35%
I leave the refrigerator door open while I think about what I am going to eat	66%	34%	70%	30%
I turn off the TV or the video game when I'm done.	81%	19%	75%	25%
I often shower for more than 20 minutes	48%	52%	48%	52%
When I'm outside, I avoid littering	92%	8%	98%	2%
When I'm cold, i put on a sweater instead of turning up the heat	66%	34%	86%	14%
I read documents or books about environmental or animal protection	35%	65%	40%	60%
I consume organic produce	64%	36%	65%	35%

In comparing the pre- and post-survey binary question results, there was a small but consistent increase in the percentages of students who engaged in pro-environmental behaviors across virtually all questions. For most questions, these gains were between 1% and 8% compared to the initial pre-survey results. The question with the highest percentage of respondents saying "yes" was "When I am outside I avoid littering". In the pre-survey 92% responded yes to that statement, and in the post-survey 98% said yes to that statement. In 11 out of 13 questions on the post-survey, at least 65% of students responded that they engaged in that pro-environmental behavior. In the pre-survey, 9 out of 13 questions had over 65% respond this way. The largest gains occurred in the "leaving water on while brushing teeth" question (the percent of "no" answers increased 10%, from 74% to 84%) and "put on sweater when cold instead of turning up the heat" (the percent of yes answers increased 20%, from 66% to 86%). Two questions had pre- and post-survey percentages that were identical. Only one question had a small dip, and that was if they "use both sides of the paper to write or print a document". That question had 67% choose yes in the pre-survey and 65% say yes in the post-survey. However, the -2% difference was not statistically significant (2-Prop Z-Test, n_{pre}= 89, x_{pre}=60, n_{post}=63, x_{post}=41, α = .05). In fact, for the binary questions the only statistically significant difference at α = .05 was found in the "put on a sweater when it's cold" question. For the scaled questions, the results of the pre-survey and post-survey are found in Table 5.

Table 5 - Average Score Response on a 1-5 Scale				
1 = Strongly Disagree, 5 = Strongly Agree				
	Pre-Survey		**Post-Survey**	
Statement	**Average**	**Standard Deviation**	**Average**	**Standard Deviation**
Climate change is a serious problem facing our planet.	4.26	0.98	4.49	0.79
Climate change is a political issue	3.43	1.08	3.46	1.04
I am aware of current environmental issues	3.91	0.86	4.08	0.76
I am concerned about the current state of our planet	4.2	0.89	4.38	0.79
MY individual actions have an impact to influence the greater good of our planet	3.76	1.05	4.1	0.77
I notice the natural world around me (trees, flora, fauna, etc...)	4.17	0.81	4.41	0.79
MY actions are eco-friendly. (recycle, use reusable water bottles, use reusable bags, attempt to use less plastic, etc..)	3.6	0.87	3.83	0.75
The planet has a high level of interconnectedness (the interdependency between the abiotic and biotic features on earth)	3.97	0.93	4.25	0.76
The United States is environmentally responsible	2.89	1.18	3.19	1.12
I am an environmental steward. (Stewardship refers to the responsibility to protect the environment through recycling, conservation and restoration)	3.34	0.83	3.52	0.91
Average Score Response on a 1-5 Scale				
1 = Very Often, 5 = Never				
	Pre-Survey		**Post-Survey**	

Question	Average	Standard Deviation	Average	Standard Deviation
How often do you yourself watch the news?	2.9	1.07	2.71	1.08
How often do your parents watch the news?	1.71	0.97	1.54	0.73

Like in the pilot study, the statement with the lowest average was "The United States is environmentally responsible", with a mean response of 2.89 in the pre-survey and 3.19 in the post-survey (1 = "Strongly Disagree" and 5 = "Strongly Agree"). The statement with the highest average response in both the pre- and post-survey was "Climate change is a serious problem facing this planet" with 4.26 and 4.49, respectively. This was also the case in the pilot study, so there was consistency among two different cohorts in both the highest and lowest scoring statements. Of the questions that scaled from "Strongly Agree" to "Strongly Disagree", the average increase between the pre-survey average and the post-survey average was 0.218. Overall, the average score was a 3.75 in the pre-survey and a 3.97 in the post-survey of those scaled questions.

Every question in this group experienced an increase from the pre- to post-survey, with the smallest increase being 0.03 on the "Climate change is a political issue" statement and the largest being 0.34 on the "MY individual actions have an impact to influence the greater good of our planet" statement. With regards to the latter statement, the percentage of "Agree" responses rose from 43% to 49%, and the percentage of "Strongly Agree" responses rose from 25% to 32%. The standard deviations of these statements were fairly consistent but did have an average decrease of 0.1 from the pre-survey to the post-survey. This indicates that the answers to the statements had a smaller spread in the post-survey than they did in the pre-

survey. Given that the averages increased, it is generally the case that these smaller standard deviations came from fewer "Strongly Disagree" and "Disagree" answers being chosen proportionally in the post-survey as compared to the pre-survey.

For the final two questions using the "Very Often" (score of 1) to "Never" (score of 5) scale, it is clear that students watch the news less than their parents. In the pre-survey, students averaged a 2.9 response. The number of students who claimed they watched the news "often" was almost identical to the number of students who reported they watched the news "rarely", 31 and 32, respectively. In the post-survey, the average changed slightly to 2.71, indicating proportionally more students reported watching the news in the post-survey than the pre-survey. This can be seen in the number of students responding "often" (22) compared to "rarely" (16). In addition, even though there were fewer respondents in the post-survey, one more person stated they watched the news "very often" (8) in the post-survey than the pre-survey (7). Possible reasons for this will be explored in the following section.

Like in the pilot study, the majority of students report that their parents watch the news "very often" in both the pre-survey and post-survey. The average did change slightly, from 1.71 in the pre-survey to 1.54 in the post-survey (recall that a response of 1 means "very often"). This was due to a change in the percentages of respondents choosing "rarely" in the pre-survey (10%) and the post-survey (3%). There was also a slight decrease in the percentage of "neutral" responses. Those changes impacted the percentages in the "often" category, which increased from 28% to 35%, accounting for the slight change to the overall average score. To statistically compare these averages, normally a paired t-test would be computed. However,

because of the anonymity of the survey participants and the unequal sample sizes due to the change in the learning environment (in class versus distance learning), the data cannot be considered paired for the purpose of the test. In place of this, an unpaired t-test was run. There was no statistically significant difference in the means in this question (2-Sample t-Test, n_{pre}= 89, $\bar{x}_{pre}$=1.71, s_{pre} =0.97, n_{post}=63, $\bar{x}_{post}$=1.54, s_{post} =0.73, α = .05).

Discussion

This study established that there was consistency in responses across two different cohorts in 2018-2019 and 2019-2020 in terms of pro-environmental behaviors and beliefs. While establishing the direct impact of environmental education on pro-environmental behaviors remains an ongoing question, in part because of the unique difficulties in distributing the pre- and post-surveys, it is clear that these students generally report that they do in fact engage in pro-environmental behaviors. This is consistent across both cohorts studied. In the aggregate, these students believe that climate change is a serious problem and they are concerned about the state of our planet. They have concerns that the United States is not environmentally responsible. They do generally believe their actions do have an impact on the planet, though.

Pilot Study

In the pilot study, the majority of students claim that AP Environmental Science had a positive effect on their environmental beliefs and actions. Because this survey was given only at the end of the school year, it was not possible at that time to do an analysis of whether this course changed their environmental beliefs and actions.

An interesting note in the pilot study is that while 85.8% of students either "agree" or "strongly agree" that they are concerned about the environmental state of our planet, only 63.2% of students believe that their individual actions have an impact to influence the greater good for our planet. This indicates a disconnect between how students view their role in improving the environment. While these students do tend to engage in simple tasks like shutting off water when brushing teeth (73% said they turn off the water) and turning off the television or video game system when finished (91% claim to do this), significantly fewer believe these actions will truly impact the environment. This shows that it is extremely important to focus on individual environmental beliefs, as students will continue to engage in pro-environmental behaviors even if they do not tend to believe it is making an influence on the greater good.

It is also interesting to note that 43% of students report they often take showers longer than 20 minutes. Though each student has studied water shortages and is aware of the depletion of aquifers such as the Ogallala, significantly more students in this category report that they do not engage in this pro-environmental behavior (short showers) than with things like turning off lights or recycling. This may be due in part to the fact that New Jersey has not had any droughts in recent memory for these students. It would be interesting to compare these responses to responses of students who have taken AP Environmental Science in other parts of the country, specifically in those areas hit with frequent water shortages. That a difference might exist in this pro-environmental action regionally would not be surprising given the hyperlocal nature of this particular issue.

Paired Study

The frequency with which students responded that they and their parents watched the news increased from the pre-survey to the post-survey. For students, this could be attributed to a desire to be more aware of the world around them due to information learned in AP Environmental Science or that the pre-survey made them more aware of this behavior. However, because we are currently (Spring 2020) in a global pandemic, and New Jersey is one of the major hotspots not only nationally but worldwide, the increase in news consumption could be due to this event. Without further follow-up, it is not possible to identify the cause as the reason for increased news consumption in the background of current events in New Jersey and the world.

As mentioned in the results, virtually every question saw at least a slight increase in the average response for the associated pro-environmental behavior or belief. Attributing these increases to students taking AP Environmental Science is difficult with the challenges to the process described previously and in the "Limitations" section, including the timeframe the pre-survey was given and the change in procedure being in-class versus distance learning. However, it is interesting to note that the averages for many of the questions in the post-survey were strikingly similar to the averages in the pilot study. Like in the pilot study, the post-survey was given after all content had been covered in the course. - and thus - comparisons can be drawn. In the statement "Climate change is a political issue", the post-survey average was 3.46. In the pilot study, the average was 3.48. Other questions with nearly identical averages include "I am concerned about the current environmental state of our planet" with a 4.46 in the pilot and a 4.38 in the post-survey. Recall that this question was slightly modified in the

capstone, with the word "environmental" removed from the capstone version. The difference in averages was so statistically insignificant that it appears the removal of the word had little effect on the implication of the statement.

This similarity in responses was also seen in the binary response questions. Like the scaled questions, the binary responses were very similar when comparing the two cohorts from 2018/2019 and 2019/2020. In many cases, only a few percentage points separated the yes/no splits in the pilot and post-survey responses. One question that did see a significant difference, however, was "When home, I put trash in the proper recycling bin". In the pilot study, 66% responded yes, whereas in the capstone post-survey 83% responded yes. This 17% gap was the largest of any question. It is difficult to rationalize why such a large disparity would exist. However, several possible explanations come to mind. One is that while the high school does have recycling bins, students are aware that when garbage is collected, both garbage and recycling get dumped into the same bin. Another explanation could be simply that more students in this year's cohort have parents who use recycling bins in their house than last year's cohort. From an information standpoint, no extra information was provided during the class year about recycling and waste that would account for a sizable change in the number of students who recycle properly at home.

Study Implications

Despite a number of limiting factors to the analysis of the data, there are still takeaways that can be applied. Research has shown that while there are a number of variables that affect pro-environmental behaviors, the amount of information presented to an individual can affect their

motivations with regards to anthropogenic climate change. Climate change anxiety is released, in a way, when engaging in pro-environmental behaviors. However, this can only happen when there is enough information presented to sustain this behavior (Kapeller 2019). To that end, a class like AP Environmental Science has the potential to produce these responses through the sheer amount of information covered throughout the school year. While other science courses in the high school setting do cover some environmental material, the "big picture" of interconnectedness is only the focus of an actual course in environmental science. So, the snippets of environmental education students receive in courses like biology and chemistry may not be enough to increase pro-environmental behaviors. The Next Generation Science Standards, released in 2013, do incorporate concepts like climate change directly into its standards (NGSS n.d.), but it is still incumbent on individual school districts to rewrite curriculum to infuse these standards into these core science courses. Because these standards are only touched upon in specific units of any given course, and because they do not present as the central theme to the course, it is debatable if they form the basis for enough immersion to increase pro-environmental behaviors without taking a specific course in environmental science.

It is also true that parents have a large impact on the environmental actions and behaviors of teenagers. Teenagers generally have less internal motivation than parents when it comes to pro-environmental behaviors. Research has shown that parental influence through established norms and parents' pro-environmental actions have an effect on the pro-environmental behaviors of children (Grønhøj 2017). As noted previously, a higher percentage of students this year claimed that they used proper recycling bins at home for their trash. While exact

reasons for this are unknown, it could be that their parents have established that norm in the house, and a higher percentage have internalized it as an action. Going back to the theory of planned behavior, Azjen (1985) determined that behavior is shaped in part by what others around you believe. If the percentage of parents of students in the 2019/2020 cohort who believe recycling is important is higher than in the 2018/2019 cohort, this could shape behavior of the students at home and account for the difference. Further research would be needed to determine if such a connection exists.

The creation of the Advanced Placement Environmental Science course legitimized the place of environmental science course offerings in high schools to many administrators (Edelson 2007). Unfortunately, despite student responses that this course has changed their pro-environmental beliefs, there is still work to be done in this area. Only approximately 66% of high schools currently offer environmental science courses in the United States (NSSME 2019). A full one-third of students do not have access to environmental science courses. It is imperative that school systems that do not offer this course update their curricular offerings to include this option. The Advanced Placement test numbers provided in the introduction show that this course is growing each year in popularity among students (an approximate tripling of the number of students taking the AP exam in the past decade). All school districts would benefit from implementing an environmental science course.

Unfortunately, in addition to schools not offering environmental science courses, Advanced Placement courses have generally been elusive for lower income students. The percentage of students from lower income families taking Advanced Placement courses is significantly lower

than middle- and upper-class students (CT Mirror 2018). While it is beyond the scope of this research, the disparity in Advanced Placement course access should be concerning among different socio-economic groups. The Freehold Regional High School District, as described previously, is upper middle class. To what extent these students engage in pro-environmental behaviors in comparison to other socio-economic groups because of their living situations and access to resources is a question for further exploration.

Study Limitations

The design of the capstone study was based upon the concept of pre- and post-surveys. The pre-survey was to have been given in September, and the post-survey given after all new content had been completed. In that way, a baseline measure could be established in which to analyze data as to the effect AP Environmental Science has on the pro-environmental behaviors and beliefs of this cohort of students. Unfortunately, setbacks in obtaining IRB certification and a delay in gaining approval from the local Board of Education meant that the plan to give the pre-survey in September before instruction started had to be modified. As a result, when the pre-survey was given there had been approximately four months of instruction completed. It is entirely feasible, and perhaps probable, that the differences found between responses in the pre-survey and post-survey would have been larger had the initial timeframe been able to be followed. In addition, as stated earlier, the pre-survey was given in person during class time (though the survey itself was taken on a computer through Qualtrics). However, the post-survey was distributed online in a remote learning environment during the COVID-19 pandemic. Likely because of this, there was a significant reduction in the number of students that responded to the post-survey (63 students) compared to the pre-survey (89

students). Given the cohort size, a reduction of 26 students has implications for the interpretation of results. One potential issue is the possibility that the post-survey data now has a larger voluntary response bias than the pre-survey. While in the pre-survey students had the option to refuse to participate, they all nonetheless logged into Qualtrics and clicked that they did not choose to participate. In the post-survey, many students simply did not click the Qualtrics link at all. This introduces the possibility that the voluntary nature of clicking on the link in the remote learning environment created a situation where those more inclined to engage in pro-environmental behaviors were also more likely to click the link and take the survey. Because of the anonymous nature of the surveys, the only identifying information given was gender. In the pre-survey more males responded than females. In the post-survey, more females responded than males. Research has shown that pro-environmental behaviors have generally been characterized as feminine (Swim 2019). Given this, the change in response rates based on gender introduces a potential lurking variable that may have skewed results between the pre-survey and the post-survey.

Future Research

These results were from a single cohort at one school from two surveys given in the middle and end of the school year. It provides good baseline information, but it limits the analysis that can be done at this stage as discussed previously in the results section. Future research should ensure that the pre-survey is given at the start of the school year before instruction has begun. This would help to ensure that impacts of the class can be more directly measured. In addition, the scaled questions could be further developed. For example, rather than asking if "students are aware of environmental issues", they could be asked if they are aware of local

habitat restoration projects. In this way, the answers might potentially be more accurate by focusing respondents on specific environmental issues rather than a broad, interpretive statement.

It would also be useful for data to come from multiple schools from a geographically diverse cross-section of the United States. In this way, research can determine if differences in impacts arise depending on geographic location using statistical analysis. This is important because the theory of planned behavior posits that many background factors can possibly influence individual beliefs. One of these factors is socioeconomic status. If a diverse group of schools is given this questionnaire, this data can be isolated and tested for impact. Comparisons of individual questions, such as the 20-minute shower question, can also be compared to test for regional influences. It might also be helpful to include questions regarding household practices to inform context for the results. For example, are there recycling bins in the household? Do the parents and guardians model recycling of items in the household?

A longitudinal study following groups of students from schools across the United States would also be of interest. A study like this could follow these students from elementary school through high school. The reality is that even taking a standalone class in environmental science, students have been exposed to many of the ideas taught in environmental science throughout their academic career prior to taking the environmental science course. A longitudinal study could more accurately assess the impact of a specific environmental science course, by following the development of pro-environmental behaviors in children as they progress through their academic career.

Further, results could be compared for students who take a stand-alone environmental science course to those students who do not take an environmental science course. This could help to identify the impact of environmental science on pro-environmental behaviors. It might also be possible to design a test that can investigate the influence of parental beliefs on the pro-environmental behaviors of children through a longitudinal study. Another interesting outcome could be investigating how peer groups affect the pro-environmental behaviors of students. As students grow older, what is considered socially acceptable behavior within peer groups changes as well. Do individual pro-environmental behaviors change in response? If so, to what extent? Could a longitudinal study be designed to test for this impact? If so, it could lead to suggestions on instructional techniques that can be used to counteract any negative changes in pro-environmental behaviors associated with peer groups. For example, wearing masks in public has long been socially acceptable behavior in some Asian countries. In the United States, this is not the case. However, the current pandemic has changed this for many residents of the United States. It will be interesting to see if the behavior of wearing a mask in public continues after restrictions associated with COVID-19 are lifted. If peer groups no longer deem it socially acceptable to wear masks in public, then usage will likely decline drastically. Similarly, if school-aged peer groups can be targeted early enough and pro-environmental behaviors such as recycling and avoiding littering can be seen as acceptable, would that be enough to ensure these behaviors can be established as long-term, internalized actions?

With regards to questions 24 and 25, the questions asking about visual news consumption, it could be further drilled down to political leaning. In other words, are environmental beliefs and behaviors positively or negatively correlated with which specific news channels are consumed?

New questions would need to be added to the questionnaire, but it may be a worthwhile avenue of further research. In addition, the questionnaire could contain personal questions (such as ethnicity, age, and location) to determine if the correlation is present to a specific subcohort. When applying the theory of planned behavior to pro-environmental behaviors, it is posited that these background factors all have impacts on outcomes (Azjen 1985, 1991, 2005). Care would have to be taken to create a survey that minimizes risk for participants when collecting these kinds of personal data.

Conclusions

There are several key observations to take away from this study. These include:

- A consistency of responses to survey questions across two separate cohorts of Advanced Placement Environmental Science students over two separate school years;

- Student responses show they are concerned about the state of our environment;

- Student responses show they believe their individual actions can impact the environment;

- While students expressed a high degree of concern for the environment, they were much less supportive of the belief that the United States is environmentally responsible;

- Pre- and post-surveys have the potential to determine the degree in which Advanced Placement Environmental Science impacts the pro-environmental behaviors and beliefs of students, but more research needs to be done in this area; and

- It may benefit future research to include personal information of the participants to better investigate the link between pro-environmental behaviors and the theory of planned behavior.

There is ample evidence that environmental science education can help to form a foundation for environmentally sustainable practices in children. School districts that do not offer environmental science as a stand-alone course should develop it as soon as possible, ideally by incorporating the NGSS into the framework of the course. School districts that currently offer the course should seek to expand student access. By investing in environmental education, we are taking positive steps towards a more sustainable future.

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Appendix A

Bar graph outputs from Google Forms for questions reported in Table 2 and Table 3

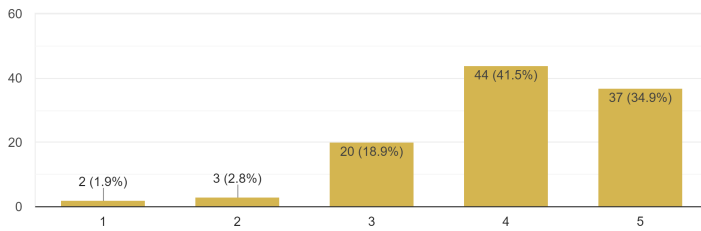**Climate change is a serious problem facing our planet.**
106 responses
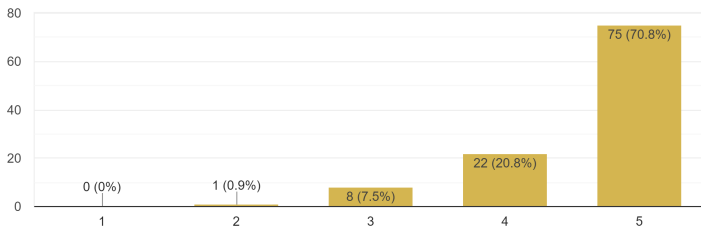
Climate change is a political issue
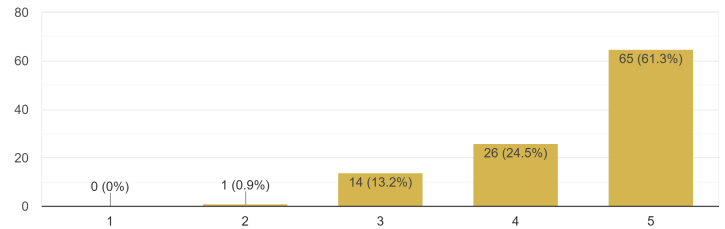106 responses
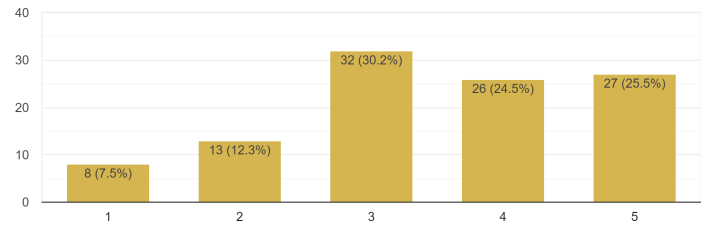
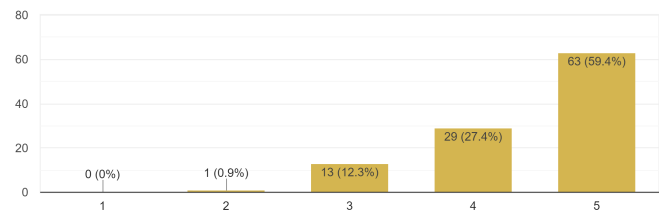**I am aware of current environmental issues**
106 responses

I am concerned about the current environmental state of our planet
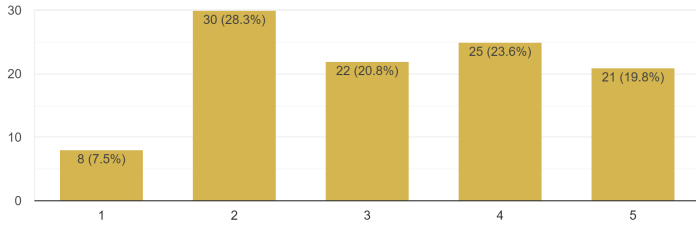106 responses

I am more aware of the environment after taking AP Environmental Science (notice trees, flora, fauna, sky, etc...)
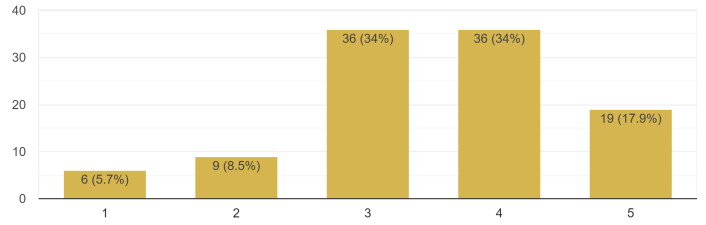106 responses

The United States is environmentally responsible
106 responses

Bar chart values:
- 1: 8 (7.5%)
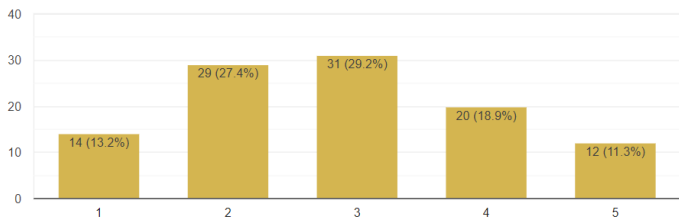- 2: 30 (28.3%)
- 3: 22 (20.8%)
- 4: 25 (23.6%)
- 5: 21 (19.8%)

I am an environmental steward. (Stewardship refers to the responsibility to protect the environment through recycling, conservation and restoration)
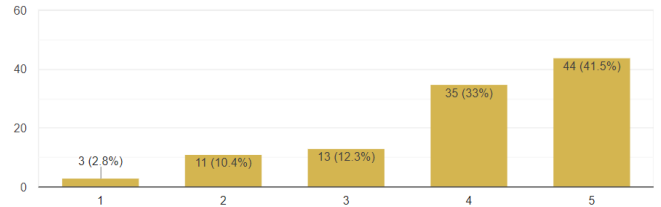106 responses

Bar chart values:
- 1: 6 (5.7%)
- 2: 9 (8.5%)
- 3: 36 (34%)
- 4: 36 (34%)
- 5: 19 (17.9%)

How often do you yourself watch the news
106 responses

Bar chart values:
- 1: 14 (13.2%)
- 2: 29 (27.4%)
- 3: 31 (29.2%)
- 4: 20 (18.9%)
- 5: 12 (11.3%)

How often do your parents watch the news
106 responses

Bar chart values:
- 1: 3 (2.8%)
- 2: 11 (10.4%)
- 3: 13 (12.3%)
- 4: 35 (33%)
- 5: 44 (41.5%)

MY individual actions have an impact to influence the greater good of our planet
106 responses

Bar chart values:
- 1: 2 (1.9%)
- 2: 3 (2.8%)
- 3: 34 (32.1%)
- 4: 34 (32.1%)
- 5: 33 (31.1%)
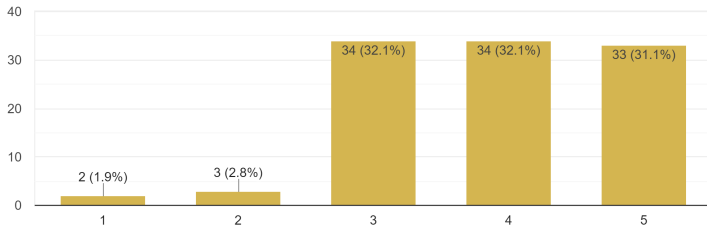
The planet has a high level of interconnectedness (the interdependency between the abiotic and biotic features on earth)
106 responses
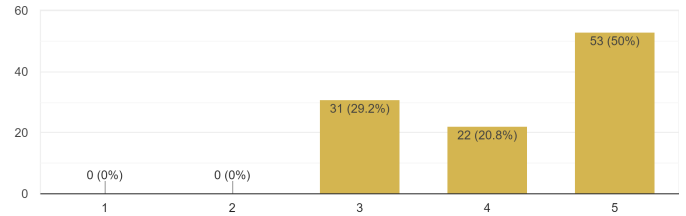
Bar chart values:
- 1: 0 (0%)
- 2: 0 (0%)
- 3: 31 (29.2%)
- 4: 22 (20.8%)
- 5: 53 (50%)

After taking AP Environmental Science, MY actions are more eco-friendly than before completing this class. (recyc...s, attempt to use less plastic, etc.)
106 responses

Bar chart values:
- 1: 4 (3.8%)
- 2: 5 (4.7%)
- 3: 22 (20.8%)
- 4: 43 (40.6%)
- 5: 32 (30.2%)