

**IMPACTING THE ENVIRONMENTAL AWARENESS
AND PERSONAL ENVIRONMENTAL BEHAVIORS
OF HIGH SCHOOL BIOLOGY STUDENTS
THROUGH ACTION PROJECTS**

by

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A professional paper submitted in partial fulfillment
for the requirements

of

Master's of Science

in

Science Education

MONTANA STATE UNIVERSITY
Bozeman, Montana

June 2011

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Erin Anna Quintia

June 2011

DEDICATION

There are two people who have helped me immensely throughout the process of completing this paper and throughout my life. Therefore, I would like to dedicate this paper to my mother, Cheryl Stransky, and my husband, Kyle Quintia. Mom, thank you so much for your continued support, believing in me when I didn't believe it was going to happen, and the hours you spent editing my writing. Kyle, you were always there, even when I was really scary to be around and completely stressed-out. You were there, with a kind word or a gentle touch. Thank you.

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ABSTRACT

This research project examined personal environmental behaviors of high school freshman biology students who were exposed to environmental topics in class and participated in environmental action projects. The effectiveness of classroom lessons and action projects on student's environmental behaviors were evaluated. The student's environmental awareness and voluntary environmental behaviors were monitored throughout the year by in class surveys, short answer responses, informal classroom discussions/interviews and teacher journals. Findings suggest that changing voluntary behaviors is not a quick and easy process. However, the researcher was able to see continued voluntary environmental behaviors in a portion of the students after the completion of action projects.

INTRODUCTION AND BACKGROUND

Project Background

Teaching and Classroom Environment

I have taught the two required science classes at Columbia Falls High School in Columbia Falls, Montana, freshman Biology and sophomore Integrated Science, for the past five years. For most of my students (60-70%), these science classes will be their final exposure to science before they graduate, become voting citizens and make their own decisions. Therefore, I feel a strong responsibility to expose my students to a broad, well rounded and appropriate base of scientific information. As a rational person I understand very few of my students will become scientists as adults. However, science information is not just pertinent to scientists; our future is becoming more and more intertwined with science each decade. All my students will become voting citizens, and it is my desire to prepare them for their duty to be informed and involved citizens. I believe the value and protection of our environment is one of our most important responsibilities as citizens. This responsibility is increasingly important as the human population continues to explode, while our limited resources are consumed at record speed. I would be remiss in my duty as a science teacher if I did not teach environmental education.

Environmental education and awareness is critical for my student's future, along with the accompanying sense of empowering students to achieve as they change their environmental behavior.

School Demographics

Columbia Falls High School serves 774 students from 9th – 12th grade. We do not offer advanced or foundations classes in biology, so I have the full spectrum of student abilities represented in these classes. Socio-economically, the students represent middle class to poverty stricken levels. At Columbia Falls High School, 45% of the students qualify for free and reduced lunch. This number has been on the rise since I began working here five years ago, due to the reduction in employment at the aluminum plant and lumber mill in town. Our student population consists of; 97% Caucasian, 2% Native American and 1% other students.

Project Focus

The focus of my action research project is how to successfully incorporate environmental issues into my biology classes, while utilizing action projects to educate students regarding their personal environmental behaviors. I realize this is not an easy topic to research, but it is something that I feel passionately towards. My focus builds informed citizens/students who will leave school feeling empowered to tackle difficult environmental problems. Environmental issues are the important topics of our future. However, these issues can also be very overwhelming and leave students feeling helpless. When faced with an overwhelming issue students either; 1) ignore it, or, 2) meet it head on and do something about it. We have so much apathy in our society right now; I want to develop skills for action within my students.

There are two concerns I want to pass on to my colleagues through my action research project. Firstly, I hope to spark improved environmental actions throughout the school. Secondly, I hope this action research data supports my continued claim that we should offer an Environmental Science class at our school.

Research Questions:

Question:

What impact on student's environmental views and personal environmental behaviors can I promote by integrating environmental topics and action projects into my biology classes?

Sub Questions:

- A) How can I integrate environmental topics into my freshman biology classes?
- B) How are student's attitudes toward the environment affected by my class/teaching?
- C) What effect will implementing student environmental action projects at school and at home have on student's environmental behaviors?

CONCEPTUAL FRAMEWORK

In response to the question, "How concerned are you personally about environmental problems?" 85% of US citizens said "a great deal" or "a fair amount" however, efforts to change or address these issues seem fairly unsuccessful (Zelezny, 1999). This was the basis of the direction of my action research project: how can I turn concern for the environment into personal action and behavior change?

Obviously, the first item that must be addressed is how to effectively teach environmental issues within my classroom. The problem is, "As the amount of awareness or knowledge is increased, an associated change has not developed to actually solve ecological problems" (Stepath, 2004, p.11). This theme was continued throughout all the literature I read. If a person was informed of an environmental issue it did not cause environmental action. How then do we change personal behaviors and habits when existing literature consistently states accurate information is not enough? Studies cite behaviors change through action. Educational

interventions that were successful in changing pro environmental intentions and behaviors presented credible environmental information and actively involved participants (Steph, 2004).

Author/Researcher L. Chawla (1999) interviewed 30 environmentalists in the U.S. and Norway to determine the sources of their environmental commitment. The research showed that the respondents repeatedly attributed their environmental interest or action to a set of similar sources. The top five responses, in order of importance based on order and frequency respondents gave them include: 1) experiences in natural areas, 2) family members who taught them to value natural things, 3) participation in environmental or outdoor organizations, 4) destruction of a valued place and/or fear of toxic treats such a pollution or radiation, and 5) education in the form of inspiring teachers or classes. To expand on the last point, since it is the most directly related point to my research project, the most significant school memories for these individuals featured opportunities to take local action (Chawla, 1999). Therefore, I included experiences in natural areas and school educational experiences whereby students took local action.

The importance of students experiencing the outdoors and becoming actively involved was further developed in the article *Outdoor Activities as a Basis for Environmental Responsibility*. The authors stated that, “Pupils who were experienced in outdoor activities seemed to have strong and clearly definable empathetic relationship with nature. They also exhibited better social behavior and higher moral judgments” (Palmberg, 2000, p.34), which is social behavior and moral judgments from an ecological standpoint. This leads to the conclusion that responsible environmental behavior is a learned response or action. The authors continued to describe the need for increased awareness and knowledge of environmental action strategies which contributed to the motivation necessary to take personal actions. However, many people

have not realized the importance of the action component in environmental education programs until recently. This action needs to be anchored in the everyday life of the students; they learn best from problems that arise within their life which they themselves solve. It is essential that students have the opportunity to feel ownership and empowerment to be prompted to become responsible citizens (Palmberg, 2000).

Carl Stepath agreed when he stated that,

Increasing the awareness or improving the knowledge of stakeholders in our communities is important in realizing that a problem exists, but this change appears to do little to rectify ecological problems. As environmental awareness is raised and attitudes improved, minimal changes in associated ecological action skills have followed. If promoting ecological sustainability and increasing community participation are desired outcomes, then the relationship between awareness, attitudes and ecological action needs investigation (Stepath, 2004, p.1).

Stepath acknowledges that additional knowledge or awareness is an important part of environmental education however he has found that studies show that “issue awareness does not lead to behavior in the environmental dimension” (Hines, Hungerford & Tomera, 1986; Hungerford & Volk, 1990, 2003; Hsu 2004; Jensen & Schnack, 1999; Newhouse, 1990, as cited in Stepath, 2004, p.2). He further explains that developing an environmentally responsible behavior is a very complex undertaking because there are so many variables. There is a very complex non-linear relationship between many factors including attitudes, subjective norms and perceived behavioral control (Stepath, 2004). He continues by explaining that changing a behavior is a holistic lifestyle change including many elements that shape one’s ability to act in numerous

different ways, not just a linear change from a change in one's knowledge or attitude. Therefore, the design of educational programs must be very well thought out by someone experienced in developing outcome oriented strategies and curriculum (Stepath, 2004). The complexity of trying to change someone's behavior does seem a bit overwhelming; however, if the end result is developing environmentally responsible students it is worth it.

Stepath also listed what he considered an environmentally responsible citizen which gave me goals to strive for in my teaching. He described an environmentally responsible citizen as a person who has:

1. An awareness and sensitivity to the total environment and its allied problems;
2. A basic understanding of the environment and its allied problems;
3. Feelings of concern for the environment and motivation for actively participating in environmental improvement and protection;
4. Skills for identifying and solving environmental problems;
5. Active involvement at all levels in working toward resolution of environmental problems (Stepath, 2000).

Through researching I found a useful methodology outlined (Peck, 2009) which included a pre-test and post-test responses of 97 students with an instrument designed to assess knowledge and perceptions. The author gave the 6th grade students the same eleven question multiple choice test before and after a year of energy monitoring and energy conservation efforts. After the baseline data was collected the students took active roles in determining how they would decrease energy consumption at school. To keep up awareness and progress a display of the kilowatt demand, updated every minute, and the kilowatt hours consumed for that day was projected in the 6th grade hallway. After the year was completed the data from the two tests were

compared. The researcher listed the questions where the greatest and most statistically significant changes occurred. The researcher was able to analyze and evaluate where the greatest shifts in knowledge or perceptions occurred and determine how influential the project was. This logical method of data collection was effective, so I used a similar technique when looking for perception and behavior changes with my students. Rick Peck credits the positive environmental changes he saw in his project as the direct result of the students being able to see that their actions had direct and observable consequences (2009).

When looking to the future it is always smart to look at what has been done previously. Past discoveries provide the foundation for future projects. A previous MSSE student Thomas Kozikowski wrote an action research project that was geared toward his Environmental Science students increasing their positive environmental behaviors. As I developed this action research project it became apparent a pattern was emerging, students need to take action for their environmental behaviors to change. Creating treatments where students assume personal environmental action was difficult. As I read Kozikowski's presentation of "the home action challenge" I knew I found a brilliant idea. The researcher taught a variety of environmental science units throughout the year. In the units the students were provided with information, activities, labs and often guest speakers or field trips which all set the perfect background for the topics being explored. But, it was the next step which caught my eye, the challenges. For example, at the end of the water unit

students were required to attempt at least two conservation actions from the list for a time period in between 2-7 days, depending on the action. Examples of actions that were available were to put a brick in the toilet tank, to shut off the water faucet while washing hands, and/or to purchase and use no phosphate dishwashing detergent. Students were

required to have written parental verification validating the student actually did attempt the actions during the required period (Kozikowski, 2009, p. 24).

Before I read this paper I had been thinking too big regarding the action projects and was becoming overwhelmed at the task ahead of me. While I still did incorporate one large school wide project for the class, I thought these personal actions at home a great idea and included them in my project. I would venture to guess a lot of environmentally sensitive individuals began with a little vegetable garden, changing a light bulb, or adding a rain barrel and those simple changes snowballed into more and more environmental involvement.

Researchers Palmberg and Kuru reaffirmed something I have always believed, kids need to get outside. These researchers found that students with experiences in nature utilizing action skills had increased self confidence and willingness to participate in the future. The students were more willing to try new approaches without giving up and had a stronger more defined relationship with nature (Palmberg & Kuru, 2000). However, when the school year starts, the realities of limited time, limited money and limited fair weather arise, it is easy to let outdoor experiences slip. This article caused me to reflect on my teaching and I realized I need to increase my efforts to find outdoor opportunities for my students. “Various activities in outdoor education can stimulate environmental education and nature studies in suitable ways so that pupils learn about and experience nature while, at the same time, they learn action strategies to protect it. Experiences in outdoor activities offer great possibilities for the development of a strong empathic relationship to nature among pupils” (Palmberg & Kuru, 2000, p.36).

Overall, this literature review bolstered my understanding of my action research topic and the methods required to implement the project. My research focuses on improving student’s

environmental behaviors, and I have gained valuable background information in this area. The message consistently repeated in the articles highlighted the importance of the action component in environmental education. The key components to environmental action involved the issue being local and the students having ownership in the solution. Personal ownership in the solution empowers students to become active environmental citizens.

RESEARCH METHODOLOGY

The basic premise behind my action research question is, as a science teacher, is it possible to influence students in a way that will actually change their personal environmental behaviors? As I stated in the preceding section, the best way to cause a behavior change is when students have an opportunity to take personal action. Action is the integral part of my project; however, a few necessary considerations need to be appreciated to insure maximum impact is achieved.

Columbia Falls High School (CFHS) requires all students to successfully complete two science classes to meet graduation requirements. The freshman students are required to take Biology and sophomores are required to take Integrated Science. I teach both of these required classes, but chose my three Biology classes for my sample. At the beginning of the school year, I had 24 students each in both my 3rd and 4th period Biology classes and 18 students in my 1st period Biology class. Thirty two students were female and thirty four students were male. Eleven of these students are either on a special education IEP (Individual Education Plan) or a 504 plan (students with disabilities). Throughout the year my student numbers have fluctuated. We have a relatively large turnover at our high school. The principal informed me when I first

started at CFHS we had a 30% turnover rate. Within my 1st period class, of the original 18 students, only seven remain. Seventeen new students have been added to 1st period Biology, but only 14 of those are currently enrolled. Third period Biology has stayed consistent with my original 24 students. Fourth period Biology shrunk from 24 to 20 students, during that time, and two students who were added have already moved. The total sample size has only increased through the year from 66 to 67, but I lost 17 students and gained 18. As a result of the many changes in student population not all students have experienced both treatments of this study. Overall, it is my assumption this group of 67 students provided a source of data that is representative of the average freshman at CFHS and gave me valuable feedback.

As previously stated, Columbia Falls High School does not currently offer an environmental science class. Therefore, I integrated my environmental topics into a complete Biology curriculum. I did open the door for my students, however, I could not spend the time I would have liked on environmental topics. The actual lessons involved in the treatment were added to the Ecology unit and the Carbon Cycle unit. In the Ecology Unit, I added the environmental topic of solid waste, in the Carbon Cycle Unit, the environmental topic of personal ecological footprints, focusing on CO₂ emissions, was added. There are three components I included in each unit; background information, hands-on or real world experiences, and action projects. First, I presented background information for each unit. The background information provided through notes, Power-point presentations, discussions, videos and articles, which highlighted the environmental issues we currently face. Students cannot truly appreciate concepts unless they experience them. Therefore, I incorporated at least one hands-on or real world experience in each unit. For example, in the solid waste topic, rather than apprising the students on how much trash the school produces, we looked at our school trash, sorted it and

found out what we throw away every day. Lastly, I assigned a home action project to conclude each treatment. In this portion the students listed different options for actions preformed at home to improve their environmental behaviors in relation to the units we studied. The students selected from the list a set number of action projects to complete and then secured a parent signature to verify completion. Also, in the solid waste treatment unit, we discovered our group action project. A description is provided below of each of the treatment units.

The Ecology Unit

The Ecology Unit is the first unit of the year for my biology students. I teach this unit first because it is a good review and an easier content. The ecology unit is organized into two sections: an introduction to the science of biology, and understanding ecosystems, including our impact upon them. Before this year I had always described some positive and negative impacts humans have on ecosystems and left it at that. This year after we discussed the negative impacts humans have on ecosystems I told the students we were going to pick one negative impact and do something about it. The topic we picked was pollution, specifically that of solid waste.

To begin, the students watched parts of the video “Trashed.” This film featured the history of trash in this country, the negative impacts, the many possibilities for alternatives to throwing “away” trash, and a few stories of individuals running businesses that are addressing this problem. The students partook in lively discussions after each portion viewed. Next, I collected trash bags from around the school and, with a bit of grumbling, the students picked through the trash. The students then sorted the trash into recyclable items, compostable items, and trash. The students then wrote reflective responses about the trash they found at the school and what could be done to decrease the amount. What we found in the school trash was

hundreds of Styrofoam lunch trays discarded daily. When the students were given a questionnaire asking what we want to tackle as our school environmental project 95% (N=59) of the students indicated decreasing the use of Styrofoam lunch trays. Next, we organized an anti-Styrofoam campaign at the school to decrease the use of the Styrofoam lunch trays. Lastly, the students completed a take home action project to decrease their own personal trash output (Appendix A). Students then completed reflection questions on the successes and struggles with this assignment and their opinion on whether they would continue to complete any of the tasks. This unit was four weeks in length and the Styrofoam lunch tray project continued throughout the school year.

The Carbon Cycle Unit

The carbon cycle unit is a large unit which I teach in the middle of the school year that includes photosynthesis, cellular respiration, and the carbon cycle. After spending considerable time learning all the details of photosynthesis and cellular respiration, the students analyze and explain the crucial components of the carbon cycle on this planet. This year I developed a deeper investigation how humans impact this cycle.

First, I introduced a carbon cycle overview, details on how fossil fuels are formed, the greenhouse effect, CO₂ levels through history along with how this data is collected, and evidence of how scientists know about climate change. All this was presented through a lecture format. Second, the students completed mock interviews where each student was given a real-life person's information. This information described where each person lived, how they lived and how climate change is impacting their lives. Students interviewed each other to see how climate change has already impacted people around the globe (Appendix B). The students then took a

personal ecological footprint quiz at www.myfootprint.org to determine the resources they personally used and the CO₂ amounts they emitted into the atmosphere. At the end of the quiz they were also provided with a list of ways they could decrease their own ecological footprint. Lastly, the students completed a take home action project to decrease their personal impact on the planet. This included actions such as walking to school, recycling, turning off the lights when appropriate, and unplugging appliances when they are not in use (Appendix C). Students then completed reflection questions on the successes and struggles with the assignment and their opinion on whether they would continue to complete any of the tasks.

In the take home action projects for both trash and climate change environmental topics I showed students what can be done to address the issues we discuss in class. I know people become overwhelmed with the amount of negative impacts we have on the environment. I taught my students how we can take small personal actions to address these concerns. I made sure there were options which did not have start up costs and gave them plenty of time (three weeks) to complete the tasks. The carbon cycle section of this unit was two weeks in length, however, the action project was completed three week after the unit had ended.

Research Methods

I used a variety of collecting methods to gather data on student attitudes and actions. The following table is an overview of these collection methods.

Table 1

Data Collection Matrix

Sub Questions	Impacts Survey	Values Survey	Full Class Informal Interview/ Discussion	Short Answer Response Questions	Teacher Journal
A- How can I integrate environmental topics into my freshman biology classes?			X	X	X
B- How are student's attitudes toward the environment affected by my class/teaching?	X	X	X	X	X
C- What affect will implementing student environmental action projects at school and at home have on student's environmental behaviors?	X		X	X	X

My main question was, "What impact on student's environmental views and personal environmental behaviors can I have by integrating environmental topics and action into my biology classes?" My first sub question was, "How can I integrate environmental topics into my freshman biology classes?" For this question I used three methods of data collection. I facilitated a full class informal interview/ discussion, collected short answer response questions and collected observations in my teacher journal.

I found the full class informal interview/ discussion most useful for this sub question. We had multiple discussions prior to and after the movie "Trashed." These discussions gave me

great insight into what the students already understood about solid waste. However, the best discussion arose after the students sorted the school trash. The students were thoroughly disgusted; they were shocked at how much trash the school amasses throughout the day. They realized much of what we throw away is recyclable, and most of our trash was the Styrofoam lunch trays. It was through this discussion that we came up with the idea to start a school wide campaign using reusable plastic lunch trays rather than Styrofoam lunch trays. I believed this decision, because it was student driven, would increase school participation in our tray project.

The next sub question was, “How are student’s attitudes toward the environment affected by my class/teaching?” For this sub question I collected data from all five of my data collection methods, including the interviews/discussion, teacher journal, short question responses, the impact survey and the values survey. The Impacts Survey (Appendix D) asked the students to evaluate (using a Likert Scale ranking 1(never) through 5(daily)) how much they depend on the natural world, how much their personal life impacts the planet, if they know ways to decrease their personal impacts, and if they follow through with those techniques. The students were also asked to give a brief explanation of their answer. I asked the students to complete the survey before and after each treatment, as well as, after we had been running the tray project for a couple months.

Another survey the students completed at the same time as the Impacts Survey was the Values Survey (Appendix E). In this survey I asked the students to rank ten different social/moral issues in order, with number one being the issue they were most concerned about through number ten, the issue they were least concerned about. Of the ten issues four were related to environmental topics and the other six covered a wide range of non-environmental topics including abortion or gun rights. The purpose of this survey was to see if the average

ranking of environmental issues by the students would change in relation to other issues throughout the year.

My final sub question was, “What effect will implementing student environmental action projects at school and at home have on student’s environmental attitudes and behaviors?” For this question I looked at data from the Impacts Survey, short answer response questions, informal interview/discussion and the teacher journal. The short answer response questions were very informative regarding what went on at home during the student’s action project, whether the students planned on continuing any environmental actions and later whether they had actually committed to any of the environmental actions. Since there was no grade value assigned to the responses, as prescribed by the Institutional Review Board (IRB), I found the responses very honest and informative.

As noted in the Data Collection Matrix I gathered information from the teacher journal for all of my research questions. The teacher journal contains the dates and lessons that were related to this project. I noted how sufficiently the lessons conveyed information and engaged students, as well as, the general feelings I perceived from the students. Also, I wrote some specific quotes from students which I felt represented true feelings of students or things that surprised me or were in some way memorable.

Reliability and validity were considered throughout the research process. The treatment was repeated twice to look for patterns in the data. The data was triangulated for each treatment. The action projects were self-monitored by the students, monitored by parent signatures for completion and teacher-student interview data. Attitudes were gathered by student ranking, group interview data and teacher perceptions through journal entries. Also, I conversed and debated with other professionals in and out of the teaching profession on the data and

conclusions of this research. The research methodology for this project received an exemption by Montana State University's Institutional Review Board (IRB) and compliance for working with human subjects maintained.

DATA AND ANALYSIS

My main goal when I began this research was to determine, "Is it possible to add environmental topics into a complete biology curriculum thereby stimulating students to take on positive personal environmental behaviors as a result?" In the data analysis of this project I looked for patterns of student's actions and behaviors. I incorporated the student's opinions of the lessons, action projects, and personal environmental behaviors. I organized the information into the data collected through the solid waste lessons, data collected through the lunch tray project, and the data collected through the climate change lessons. In this way I would see how the students responded to each topic and if the results support my research questions.

Solid Waste Lessons and Action Project

The solid waste lessons were part of the Ecology Unit at the beginning of the year. After a brief lecture on the negative impacts of solid waste pollution the students viewed the movie "Trashed". This movie initiated some great discussion in the classes. The big topics were salvaging/reuse, recycling and fixing items. The students expressed quite a bit of knowledge on the importance of salvaging and reusing items, while this came from more of an economic necessity than an environmental awareness the realizations were the same. One student stated, "Yeah, we have found perfectly good stuff thrown away all the time."

Next, I gathered trash bags from around the school for the students to investigate. I asked the students to separate the trash into recyclables, compostable items and trash. The students were shocked by the amount of trash that we generated as a school. The majority of our trash was the Styrofoam lunch trays from the cafeteria. When asked what we should do as a school to reduce trash output 95 % (N=59) of the students said that we should stop using Styrofoam lunch trays and 55% also said that we should start recycling cans and plastic. The students were upset that I required them to sift through trash; however, it was something that they remembered throughout the entire school year. This activity also led to our group action project, which was to reduce Styrofoam tray use.

The students had built a fair amount of background information on solid waste by now. It was now time to assign the Take Home Trash Reduction Project (Appendix A). The students were given two weeks to complete three of the tasks. Each task required a signature to verify the student's completion. After two weeks I had received only 18% of the assignments. However, over the following couple weeks more projects trickled in and the total ended up being 42%. This is a constant struggle with the Freshman students at CFHS, and one of the reasons that I rarely assign homework. I remember when I first started teaching at CFHS after transferring from a Colorado school, at the first progress report a huge portion of my students were failing. I realized that the main reason was a very small percentage of the students turn in homework assignments. So, this is another battle I am fighting with the take home action projects. However, when I asked the students that did complete the tasks if they thought it was easy or difficult an overwhelming majority thought it was easy. I received comments very similar to the following students:

“Easy, it did not involve a lot of work.”

“They were pretty easy because I could easily fit it in into my everyday life, like using a plastic tray.”

“I found them pretty easy because they were just little things that can make a difference.”

I was happy with these remarks because I didn't want to overwhelm the students. I wanted them to realize that small changes can add up and make a difference and you don't have to feel overwhelmed by the enormity of environmental problems.

When I asked the students if they planned to continue completing their trash reduction tasks those who completed the assignment said that they would try to continue, especially using real lunch trays.

“I think I will continue because it's easy to do.”

“Yes we will we are going to start recycling cardboard too.”

“I will continue because it doesn't take any of my spare time and it's simple to do so.”

There was only one negative response from all the students who completed the project, which stated, “No, because it doesn't matter to me.” I was not able to follow up with this student before she moved out of town.

The most disheartening realization from the discussion/ interviews with the students about this project was the negativity from the student's own family regarding their environmental actions. This issue hadn't even crossed my mind, but one of the students during an informal class interview mentioned that her dad made fun of her for trying to reduce their families waste. I thought this issue was something I should discuss with all my students. Of the students that had conversations with their parents about this project, 31% of the parents gave negative feedback.

“My mom was ok with it, my dad gave me crap.”

“They called me a greenie. They asked if I was going to start driving a Subaru.”

“My mom just seemed irritated but she let me do it. I probably can’t keep recycling because my mom thinks it’s too big of a hassle.”

These responses were disappointing because most students will not be motivated to continue implementing environmental tasks at home if they are given a hard time by their parents. I was glad that I had listed some waste reduction tasks that the students could do at school without their parent’s oversight. Thankfully, the rest of the responses were positive, including:

“My mom thought it was really cool that I should try it more.”

“They said they would help out.”

“They thought it was cool that I was recycling.”

I asked the students four months later if they were still voluntarily completing any of these tasks. Overall I was very pleased, 70% of the students that completed the take home trash action project were continuing at least one of the trash reduction tasks. One of the responses was particularly exciting. A student who’s Dad had been very negative about the trash project initially, responded four months later saying, “I have finally convinced my parents to recycle.”

Lunch Trays – Group Action Project

Part of the solid waste lessons included a day when the students looked through the schools trash bags. We found that a huge portion of the trash we as a school were throwing away were the Styrofoam lunch trays used to serve food at breakfast and lunch. When I asked the students the question, “What can we do to decrease our waste at school?” 95% of the students responded by referencing changing the lunch tray situation. After reading these responses I

came back to the students and suggested that we take on this project. The students were excited about the challenge, but also afraid they might not be able to create the change within the school.

The Styrofoam lunch tray project would be our Group Action Project. I talked with the lunch staff and they already had reusable plastic trays in the kitchen. When I asked if they would be willing to experiment with my class and try to promote the use of the plastic trays they agreed. The students and I brainstormed ideas on how to promote the use of plastic trays school wide. One of the ideas was to make posters to hang up around the school to broadcast the idea. On the day we made posters the students were very enthusiastic. Two students told me they had asked the lunch staff for the plastic trays and had already started eating off of them at lunch. Another student said that she made a brochure about the project for a computer application assignment. While an additional student said that we should add something to the announcements in the morning and handed me a scrap of paper that read, "Please use plastic trays at lunch to help Columbia Falls High School become the green school of the Flathead Valley. Show your Wildcat Pride, Go Green!" These and other examples surprised and excited me. The students really wanted to be a part of something bigger than just the science class.

It took significant effort on my part to get the program rolling. The lunch staff did not have any method for collecting lunch trays so I hunted for bins and carts. Then the lunch staff said that they would not roll the carts in and out of the kitchen, it was too much work. My classes set up a rotation of students that would put out the carts before lunch and roll them back after lunch. Also, the lunch staff did not want to take the option of Styrofoam trays away from the students so we had to promote the project to get students to change their habits. Once the details were worked out I asked the students to set tray goals. We had only managed the trays for a couple of days, and the numbers of plastic trays used were low, the students were scared the

project may not work. None of my students thought we could get all the student body to eat off of the plastic trays. The initial participation goals for plastic tray use were around 30 or 50 trays, which is quite low since around 250 students have school lunch every day. After much classroom discussion regarding setting a plastic tray goal for the school, I wrote “Goal=125 plastic trays”, on the board, 125 trays was the highest goal stated from all three of my Biology classes. I was surprised how negative the students were stating, “Oh, we won’t be able to do that.” In the end they were right, following are the plastic tray counts for the last 6 months.

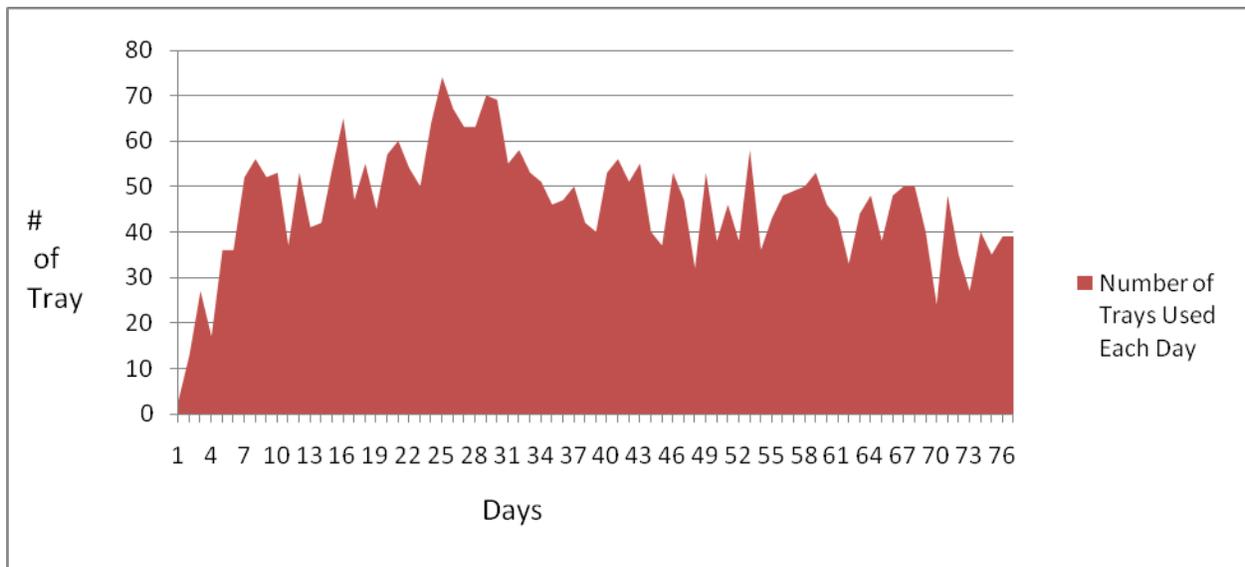


Figure 1. Number of Reusable Plastic Trays Used Throughout the Project.

The highest single day total we reached was 74 plastic trays and the use leveled out at around 40 trays per day. In the beginning the students worked hard getting the word out. Students volunteered to give out candy to those using the plastic trays and other students stood at the beginning of the line telling to students to use plastic trays. Even my sophomore Integrated Science students wanted to get involved. They would come to class and tell me when they used the plastic trays. I had two Integrated Science students say that they stood at the beginning of the

line passing out plastic trays to students in the lunch line. I found this encouraging, since I did not talk to these students about the tray project unless they asked specific questions. However, the lunch staff was very unpredictable and difficult to work with. I believe this is one of the main reasons that the project lost momentum.

At first the lunch staff would not get out the reusable plastic trays when the students requested them. Once the trays were out, they would put them off to the side so it was more difficult to grab the trays. They did not put the trays out in the “grab and go” area of the lunch room even after being asked to do so repeatedly. Some days the lunch staff wouldn’t put the plastic trays out at all and tell the students they had to use Styrofoam. Most recently a student came up to me and said, “Hey, it is Earth Day we should make an announcement before lunch that in celebration of Earth Day everyone should use plastic trays.” The announcement was made and the lunch staff didn’t put the plastic trays out. I was extremely disappointed. After a month I came in the lunch room to ask the lunch staff how the project was going and what could be done to improve it. At this point one lunch worker forced me go look at two broken trays and complained about teachers not returning them every day. I couldn’t believe that she actually made me go look at two broken trays. After this incident whenever I tried to talk with the lunch staff they were too busy and wouldn’t talk. I realized I am not much of an activist because I wasn’t persistent with the lunch staff. The discouraging thing is that I really wanted these students to set a goal and actually achieve it, but it did not happen.

Looking at the tray project as a whole it had many positive effects. First, it raised awareness of an issue that the students may not have thought about on their own. Also, it organized the students in a project that they had ownership in. When I asked the students, in the Impacts survey, “Do you implement any of the techniques you know of to improve your impact

on the planet", 28% of the students listed the fact that they now use reusable plastic trays instead of Styrofoam trays. After we had been running the tray program for six months I asked the students, "Are you using the plastic trays? Why or why not." Of the students that ate cafeteria food 45% said they always used the plastic trays, 33% of the students said they used the plastic trays sometimes depending on their plans and 31% of the students said they used the Styrofoam trays, not the plastic. Some of the reasons students didn't use the plastic trays include:

"I don't use them, because I never think to use them because I don't see them."

"I use Styrofoam because I hang out near the trash and it's inconvenient for me to walk back there when I don't have to."

"I use Styrofoam most of the time because it is easier to throw them away."

Some students were inconsistent with their usage. Many of these students seemed to want to use the plastic trays but they were not as convenient for one reason or another. I think a few steps to increase the trays visibility and ease of use could have swayed these students.

"The plastic is harder to get to. It's like they don't want us to use them."

"I use the plastic trays sometimes, because they're not always accessible."

Most of the students that are using trays did not elaborate on why, but here are a couple of the exceptions:

"I use the plastic trays because it would improve the environment."

"I do because I don't get why we make posters that say to use plastic and we don't use them."

"I use the plastic trays all the time because it's bigger and easier to carry and it helps the environment."

We did not meet our goal of 125 trays in a day; approximately 40 less Styrofoam trays in the landfill may seem like a minor impact. But the 40 students who changed their environmental behavior represent a voluntary change and that was my goal for this action research project.

Climate Change Lessons and Action Project

The Climate Change lessons and action project were incorporated into my carbon cycle unit. This is a large unit taught in the middle of the year, the majority of the unit involves photosynthesis and cellular respiration. I tie these two processes into the carbon cycle and discuss the flow of carbon on this planet. This was a perfect place to add the environmental topic of climate change. The background information was presented through a Powerpoint lecture, discussions, a clip from the TV show *Futurama*, graphing CO₂ and atmospheric temperature, and a carbon cycle drawing/coloring.

As I have stated earlier, I often incorporate a hands-on or real world application within the environmental topics for a more authentic learning environment. To help my students understand that climate change is already impacting some communities very directly I handed out personal interviews from 18 different individuals (Appendix B). Each student was asked to take on that person's identity and describe their situation to other students. Multiple students asked, "Are these real people?" When I assured my students the personal interviews represented real people they took the assignment very seriously. When I asked the students who in the world seemed to be impacted the most from climate change student's realized it was the poor. When asked who contributes the most greenhouse gases into the atmosphere the students in each class all responded either Americans or the wealthy.

In another assignment the students completed an ecological footprint online quiz. The students were able to gain information on their personal carbon footprint and resource use. The students were shown how many Earths we would need if everyone lived like them. If everyone on the globe lived like the average American we would need 5.25 Earths. The students quiz results were between 3.5 Earth's and 8.5 Earths. When asked, "Were you surprised by your results from the ecological footprint website? What did it make you think?" 13% of the students said they were not surprised noting:

"No, not really. I travel by plane to Georgia a lot. Maybe I should go there less often."

"I wasn't that surprised because I eat a lot and live in Kalispell so I'm always driving a lot."

"No, I think I was about average. I didn't think much of it."

Many students were surprised by their results. The students could be grouped into two main categories. Group 1, was surprised and their results which made them feel guilty and Group 2, was surprised but they wanted to initiate a change.

Examples from Group 1; who felt bad about their results but did not mention changing their behaviors (which only consisted of three students):

"Yes I was surprised, it made me think that for someone who tries hard to be a tree hugger I'm horrible."

"4.8 Earths, and my thought I need to work on some stuff....other words "I suck"'"

"It made me feel fat and wasteful."

Examples from Group 2; who are students that felt bad and wanted to do something about it:

“Yes, I was surprised because it shows how wasteful we are. It made me think that we need to start making a difference because we can’t get more than one Earth when most of us got at least four.”

“Yeah I was surprised; I thought I did a pretty good job of reducing my carbon footprint. I think that maybe I should try harder.”

“I was surprised how many Earth’s we would need. I thought that I need to help the Earth more.”

With the background information established, I gave my students the Climate Change Action Project (Appendix C). When I handed out the Climate Change Project, I discussed the project every day. I hoped to receive a higher completion rate by my students. I told my students I was going to complete the tasks along with them. I informed my students that I would walk to school at least three times a week, which is about a 30-40 minute walk.

Immediately after we started the project as I was talking up my walking the temperatures plummeted. The first two mornings it was -12 and -7 degrees causing me to drive. However, after that I walked everyday and talked about it with my students. Regrettably, I only had a completion rate of 39%. When asked why they did not complete the take home action project most of the responses were very similar to the following:

“I just forgot to take it home.”

“I’m way too lazy.”

“Because I forgot and it took time.”

The majority of the students that did complete the action project said they did because it was an assignment, but some expanded on this.

“Because I want to save the Earth.”

“I wanted the challenge.”

“First it was an assignment and second to change how I live to get a better lifestyle.”

All the students that completed the action project said the tasks they completed were easy; however, some students noted that there were tasks that seemed much more difficult. Three weeks after the project had been turned in I ask if they had continued the action project tasks, 73% (N=26) said they continued to complete at least one of the tasks. Examples include:

“I still carpool.”

“Yes I take shorter showers and we still have the light bulbs.”

“Yes. These tasks aren’t temporary. People have to do these tasks in order to live in a clean environment.”

One of the students responded by saying, “Yeah, actually I do.” She explained that she had started walking more. She surprised me in the hall one morning by running up to me with a big smile on her face. She said, “Guess what? I have walked to school three days in a row!” I smiled, gave her a high five and told her to keep it up. The action project was able to initiate a positive change this student continued; she was very proud of herself and enjoyed the positive affirmation from me. This was one of the take home messages for me, that many students just needed a little nudge with these environmental behaviors to continue on their own.

Attitudes

Now let’s consider the student’s environmental attitudes throughout the year. While a change in attitude does not necessarily lead to a change in behavior, it does seem to improve attitude toward the importance of the environment, and this could be a springboard toward a change in behavior. In order to determine if the student’s attitudes changed throughout the year I

gave them the values survey four times during the year. In this survey the students ranked the importance (1 the most important through 10 the least important) of political, moral and environmental issues.

First, I studied the overall class averages for the four environmental questions to see if the value they placed on these topics would increase. If the value the students placed on the issue increased, the average number would decrease. I did not find any patterns as the figure below shows.

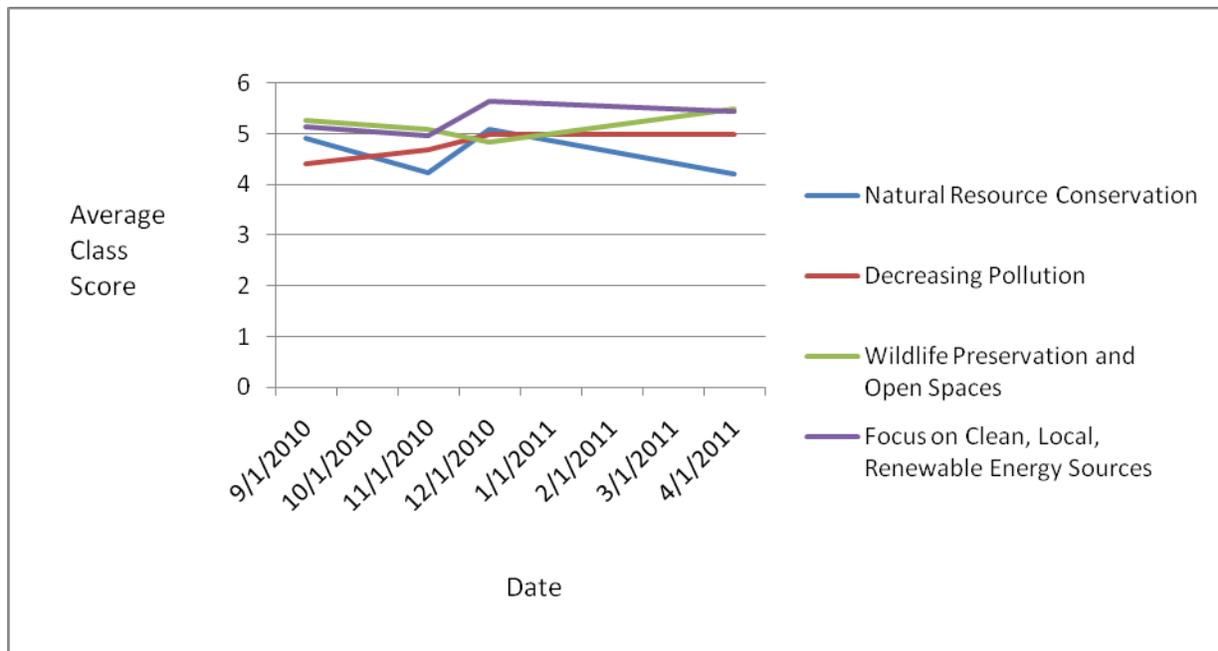


Figure 2. Average Value the Students Placed on Environmental Issues. (N= 63, 59, 60 and 46)

However, this data included new students and students that chose not to complete the take home action research. I continued to analyze the values data in multiple different ways. I compared the data before and after each treatment and saw no significant difference. I compared the data before and after each treatment including only the students that completed the action projects and saw no significant difference. I compared those students that completed both action projects

before and after completion. I focused on the issues that were directly related to the topics the action projects addressed and still saw no difference. The data from this last example is below.

Table 2

No Correlation between Completion of Action Projects and Student Environmental Values

Student Value Ranking for Decreasing Pollution

Mean Before Treatments	Mean After Treatments	t-test
4.5	4	$t_{(10)}=.307, p > .05$ or n.s.

Student Value Ranking for Focusing on Clean, Local, Renewable Energy

Mean Before Treatments	Mean After Treatments	t-test
4.6	5.3	$t_{(10)}=1.42, p > .05$ or n.s.

I was not able to identify a change in the value that students placed on any of the environmental topics at any point through out my research project. The interesting thing is that individual student data did not remain consistent. For example, a student that ranked improving the economy as the issue they were most concerned with ranked it six the next time. There was very little consistency. This leads me to put little emphasis on this data. It makes me think that student data varied for other reasons. They may have just learned something related to a specific topic, a lack of understanding of all the issues and the fact that at 14 or 15 years old the issues they find important are always changing.

Behaviors

35% of the students completed both take home action projects. I wanted to know who those students were and the logical place to start was comparing the completion of the projects to the student's current grades. As you can see below there is a positive correlation between the

grades the student's were receiving in class after the second action project was completed and whether they had completed the action projects. Students that are involved in class, have study/homework skills, understand the topic, and have support at home typically do better in class and complete work. Therefore, it was not a surprise to me that all these factors played a role in the completion of this project as well.

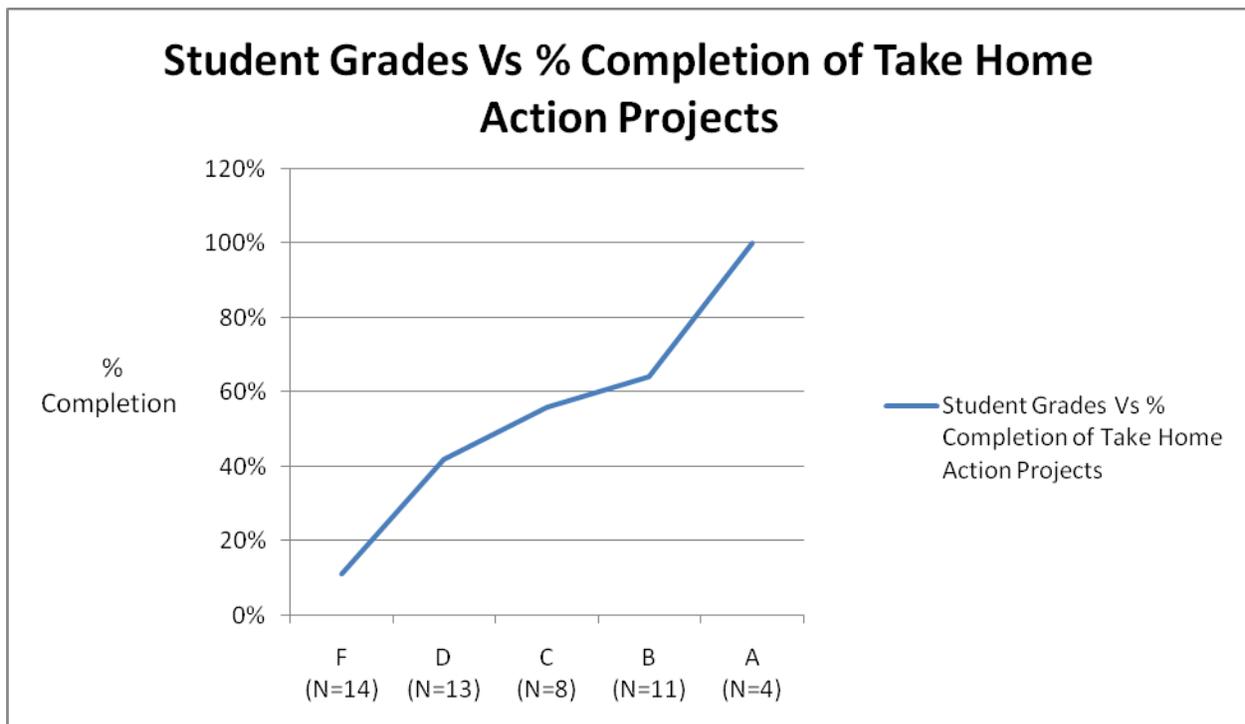


Figure 3. Student Grades Vs. % Completion of the Take Home Action Projects, (N=50)

As previous data has stated it is difficult to cause a change in behavior without students taking actions. When students did take actions through these projects many continued voluntarily completing at least one of the tasks after the assignment was turned in. In Table 3 I show the percentage of Biology students that completed each of the action projects and then list the percentage of students that continued to complete at least one of the environmental actions from that project on a voluntary basis after the project was complete. This data was collected four

weeks after the climate change action project was completed and three months after the trash project was completed. As you can see while the completion of the projects overall were low, the percentage of students that did complete the projects had high continuance rates.

Table 3
Project Completion and Voluntary Continuation Table (N=61, N=65)

% of students that completed the take home trash project	% of students that completed the trash project that voluntarily continued trash reduction tasks	% of students that completed the take home climate change project	% of students that complete the climate change project that voluntarily continued climate tasks
42%	70%	39%	78%

The number of students who completed the action project was lower than I would have hoped. The students who do not complete assignments for class also did not complete this assignment. I debated making this project worth more points to get more students to complete it; however, I was worried this would cause some students grades to drop too dramatically.

A high proportion of the students who did complete the assignment reported continuing the tasks they completed in both the trash project and the climate change project. I was very pleased with this and received many positive remarks about the project from these students. Throughout these projects many students engaged in ways that I have not seen from typical class work. Students were thinking about these projects outside of class and would come back to school with new ideas. Examples include students writing announcements for the bulletin, students emailing me questions, students asking if they could pass out candy to students that used plastic trays, students stopping me in the hall to talk about a project they are still completing or a

new environmental task they have started on their own. It all gave me the impression the students were excited about making changes in their environmental behaviors.

INTERPRETATION AND CONCLUSION

My main research question was, “What impact on student’s environmental views and personal environmental behaviors can I promote by integrating environmental topics and action projects into my biology classes?” In this section I will summarize my finding and highlight key observations. My findings indicate that students who participated in and completed the full treatments significantly improved their environmental behaviors both within and out of school (Table 3).

Sub Question A - How can I integrate environmental topics into my freshman biology classes?

When asked where students learn how to improve their impact on the planet a student at Columbia Falls High School stated,

“In biology with Mrs. Quintia because she has made more sense to me. She had us do some projects in making the world a better place.”

As I started the process of integrating environmental topics into my biology classes, I discovered I was able to incorporate appropriate environmental caveats into my traditional biology curriculum that added depth to the topic. Environmental issues such as pollution and climate change are both topics that are relevant to the Biology class and critical issues students must understand. I discovered environmental lessons and action projects which supported the

environmental topics in my Biology class. This is a process I will continue, adding more environmental topics in appropriate areas as well as environmental current events.

Sub Question B - How are student's attitudes toward the environment affected by my class/teaching?

Were you surprised by your ecological footprint?

"Yes, I was surprised; I thought I did a pretty good job of reducing my carbon footprint. I think maybe I should try harder."

The quantitative data I collected did not provide the evidence I was looking for, which was a significant change in my student's attitudes toward the environment (Figure 2 and Table 2). However, the qualitative data gave examples of students who noted increased environmental information from science classes, some students specifically sighting my name (15%). Also, throughout classroom discussions there were more acknowledgements of ways to solve environmental issues as the year progressed. This information allowed me to assume a couple of factors may be skewing the quantitative data. First, I believe many students thought they knew more about the environment than they actually did at the beginning of my class when they completed my survey. Secondly, looking back, I chose a difficult age group to introduce environmental topics. My students are 14-15 years old, and not as mature as their upper classmates. Lastly, I should have been more consistent in developing environmental connections in class on a daily basis. When the year really got rolling it was difficult to remember daily to keep the students informed of topics and actions related to positive environmental behaviors. Eventually, I would like to establish connections to the environment within each unit I teach. It

may not be a full blown action project, but at least an issue I can discuss with the class throughout the unit that brings in a real world connection.

Sub Question C - What affect will implementing student environmental action projects at school and at home have on student's environmental behaviors?

What techniques did you implement that improves your impact on the planet?

"I always use the plastic trays when they are there, recycle paper and more."

Did student environmental behaviors change? The simple answer, 'yes.'" However, all students' behaviors did not change. All the students did not complete the take home action projects, which made the process of changing behaviors difficult. Of the students that completed the take home action projects many continued to complete the tasks after the assignment was completed because they thought the tasks were easy and made a positive impact (Table 3). Many of the students continued to preform positive environmental behaviors probably wanted to act and this project was there catalyst for positive change. Most tasks from the projects were focused on making a behavioral change; however, a couple tasks were one time changes like putting in compact fluorescent light bulbs. These tasks were harder to connect to behavior change. The plastic tray school action project made it possible for the students who eat lunch at school to make small daily changes within the school environment. This was helpful for students who wanted to establish an environmental behavior change but did not have the support at home. The number of students who consistently used plastic trays leveled off to around forty students daily; these students voluntarily improved their school environmental behavior (Figure 1).

One group who has been consistently supportive of my environmental awareness efforts has been my fellow teachers. When the students started the lunch tray program many of the teachers indicated they also wanted something done about the Styrofoam trays. Once the program began, I never saw a teacher eating school lunch off a Styrofoam tray again. Even on days the lunch staff did not have the plastic lunch trays out they demanded to be given one. Also, my project has allowed me to continue my dialogue regarding the addition of an environmental science class. Since we are cutting teachers and classes from our school this year it is not the time, but I will continue to keep the discussion alive.

VALUES

The results from this research had a definite affect on my personal views regarding student personal environmental behaviors. The research demonstrated that it is possible to stimulate positive environmental thoughts and actions of Biology students by the inclusion of relevant environmental course material and action projects. The extent to which students are stimulated to think and act for the good of the environment is greatly variable and probably dependent on many factors. However, in our current political environment, I believe it is more critical than ever to give students the opportunity to initiate personal changes to address these issues. Initiating personal change the student forms their own positive behaviors and a sense of empowerment to tackle these difficult issues.

As a result of the findings from my research project I plan to continue to include Personal Action Projects throughout the school year. I will continue to include the “Trash Project” and the “Climate Change/ Eco-footprint Project.” The students that did complete these assignments

found the tasks reasonable and they continued after the assignment was turned in. I plan on improving the Climate Change Action Project to increase the selection of actions and parent involvement. There were not enough selections that could be completed in cold weather and without the investment of money. Also, the actual choices and signature sheet was not set up very well. I also have been working on an action project about food and agriculture to add to my Botany unit. The “Trashed” video was very informative and provocative. I would like to find an equally informative climate change video. I will be showing “Food Inc.” during the Botany unit. I will plan more lab experiences and guest speakers for the students which will inform the students about local environmental issues and actions being taken by the community. I have already completed a trip to the community garden with my students during the Botany Unit which the students enjoyed. This project had me pursuing a more action based teaching style which I will continue to improve upon in the future.

I am grateful that I started these action projects for my MSSE research project. I have collected volumes of feedback from the students. The responses from individual students on positive habits and the impacts of the projects were very encouraging. If I had not collected so much data I probably would have been discouraged from the results of the action projects because of the low participation. However, because I followed up with the students that did complete the projects I realized that many were positively impacted. The students liked taking personal action and making a difference and many of the students continued to do so after the project was over.

Regrettably, one very disconcerting realization from the data was that some parents were not supportive of their child’s action projects. This last realization made me think about what other factors besides my teaching is influencing whether a student is stimulated to adopt positive

environmental behaviors. How is the socio-economic demographic of the student impacting their environmental behaviors? When families are worried about feeding their family nightly, possibly they are not as concerned about the environment. What is the effect of the student and families IQ on their environmental awareness? How is a student's geographical location, city vs. mountains, impact their views? How were the students impacted by the lack of cooperation by the kitchen staff? Changing any behavior is very complex and different for every person; therefore, I will continue to be understanding to those who are still finding their way.

I have just begun using my potential to research how I can stimulate students to form positive personal environmental behaviors. There are many avenues I have not yet explored. I will continue to put forward a sustained effort to improve my position on this path of environmental awareness and action.

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APPENDICES

APPENDIX A

TRASH REDUCTION ACTION PROJECT

TRASH REDUCTION ACTION PROJECT

Introduction:

Garbage, trash, waste and refuse are all words used to describe the items people discard, collectively referred to as municipal solid waste (MSW). MSW is an industry, a science and a factor in human health. We can look at waste from economic, social, environmental and cultural viewpoints. Waste affects many aspects of our lives. No matter who we are or where we live, we create waste. From medieval Europeans tossing their refuse out the window to modern waste-to-energy plants, people have taken different views of the waste they generate, depending on their lifestyle and available technology.

Waste is continually created and discarded, which results in a system known as the waste stream. The waste stream is the flow of waste from generation, through separation and collection, to final disposal. The waste stream originates with people. People use materials, create products and then discard wastes. This connection means that people have a direct effect on the amount and type of wastes that enter the waste stream. People affect the waste stream by what they buy, what they choose not to buy, what they reuse or recycle and what they throw away.

Current methods of dealing with the MSW generated in the United States include source reduction, recycling, composting waste combustion and landfills.

Recently I toured the Flathead Landfill and talked with the landfill operations manager. They have some great cutting edge techniques they implement to decrease our

Reducing Trash Project

Below I have listed nine options for reducing your personal waste stream. Over the next two weeks I would like you to try at least three of these options. If you would like to think of a waste reduction technique of your own that would be fantastic just make sure you clear it with me first. If you have any questions feel free to ask me at school or email me at quintia@sd6.k12.mt.us.

_____ - Use the real trays when you eat school lunch. Dates: _____ and _____ Have someone you ate with sign for verification: _____

_____ - Recycle. Working with your parents find a way that you can separate out your recycling from your trash. If your family goes to the CFalls trash bins they recycle cardboard, paper, plastic (1&2) and aluminum. All you need to do is place it in these bins instead of the trash.

Parent signature: _____

_____ - Reusable Bags. If you go grocery shopping bring your own bags (they could be canvas or old plastic bags) to the store. Smith's will give you 5 cents off your bill for every reused bag you use.

Parent signature: _____

_____ - Junk Mail. There are a lot of no junk mail websites that you can sign up to get on a no junk mail list. They are usually free or a couple bucks. Make sure that this action is OK with your parents.

List the website you found: _____

_____ - Compost. This could be a big step in decreasing your waste, but will take some planning. If you want to try to start composting feel free to consult with me for ideas.

Started composting!! Parent Signature: _____

_____ - Reuse. Find something that is not functional anymore and find new use for it; be creative. Example: Trade clothes with a friend, reuse something for a craft project, wash out Ziploc bags and use them again..... Describe what you did: _____

_____ - View the video: The Story of Stuff at www.storyofstuff.com . After you are finished write a paragraph about your reaction to the video. Was the video new information or not, was it informative or dull, did it make you think, did it seem well researched or not, etc. Attach the paragraph to this paper.

_____ - Donate old clothes or furniture to charitable organizations or second hand stores.

What did you donate? _____

Where did you donate? _____

Parent Signature: _____

_____ - Reduce the amount of paper you use by printing on both sides of the paper.

List at least 3 examples of when you did this and the date:

APPENDIX B

CLIMATE CHANGE INTERVIEWS

Climate Change Interviews**Matthew Gilbert, Gwich'in****Northern Alaska/Northwestern Canada**

I am a member of the Gwich'in, the northernmost Indian nation on the American continent. There are about 8,000 Gwich'in. Because of global warming, we are threatened as a people.

We survive mostly from hunting caribou. Less snowfall is making sled and snowmobile transportation more difficult. Creeks are freezing later, and the ice is too thin to carry heavy loads. Lakes are drying up.

The worst threat is to the caribou. In ten years, their number dropped from 178,000 to 129,000. Calves drown when they try to cross rivers that are usually frozen. My grandfather remembers vast numbers of caribou moving in waves near their village during spring and summer. No more. Our environment is in chaos. The hunters find it harder and harder to find the caribou that feed our people.

We must reduce greenhouse gases. My people are dying.

Anisur Rahman, Bangladesh

I am the mayor of Antarpara, a village in Bangladesh. Antarpara is on the Brahmaputra River that flows from the Himalaya Mountains in India. We are in the lowlands, and our village floods every year. We are used to it, and, in fact, the flooding is good because it leaves our land more fertile.

But now the floods are much worse. Now the floods are huge and each year they destroy our homes and carry off the land underneath them. My village used to have 239 families. Now we are 38 families. But where can we go when our homes are gone? Our country has 150 million people — the most densely populated in the world. I have an 18 month old child. By the time she is grown, this village won't be here.

Where are we supposed to go? Do we all get tickets to America?

Larry Gibson, Kayford Mountain, West Virginia

They say that to move away from oil we need to rely more on “clean coal,” mined here in the USA.

Clean coal. That’s a lie. That so-called clean coal comes from mountains in Appalachia that have been destroyed by coal companies, like Massey Energy. They blast mountains apart to get at the coal and dump everything they don’t want in the valleys and streams, poisoning everything around.

When they talk about “clean coal,” they sure don’t mean how they got it. They want you to focus on the fact that burning coal today produces less sulfur dioxide than it used to. That’s the stuff that causes smog and acid rain. But burning coal still releases about twice as much carbon dioxide as oil — for the same amount of energy. And carbon dioxide is a greenhouse gas, the gases that cause global warming.

So mining coal is bad for the people of Kentucky and West Virginia, but it’s also bad for the planet.

I’ve been fighting mountaintop removal of coal for over 22 years. I’m not gonna sit around and watch my home and the planet be destroyed. The coal companies care about the money. For me, it’s not about the money. It’s about the land. My mother gave me birth. The land gives me life.

Koleo Talake

Prime Minister, Tuvalu

Most people have never heard of my little island that is 400 miles from Fiji in the South Pacific. Tuvalu has 10,000 people in a place that averages just 6 feet above sea level. My people live on fish and fruit; everyone knows their neighbors and people don’t even lock their doors.

Rising sea levels, caused by global warming threaten the very existence of my land and people. Beginning in 2000, at high tide the water began covering places in the island that had never before been covered in the memory of even the oldest residents. In August of 2002, the entire island flooded and the increased salinity has forced families to grow their root crops in metal buckets instead of in the ground. Many people believe that if current trends continue, there will be no more Tuvalu in less than twenty years.

The former Prime Minister of Australia said that if Tuvalu disappears, then people there should be relocated elsewhere. What incredible selfishness. How can anyone say that people in Tuvalu should suffer so that people in the so-called developed world can continue to fill our atmosphere with carbon dioxide by driving their SUVs and buying stuff made half-way around the world? This is sick. That is why I have been speaking out.

Chris Loken, Apple grower

Hudson Valley, New York

Everybody is saying awful things about global warming, and I know that it's bad for a lot of people. But recently Fox News did a report on the "winners" of global warming and they came to talk to me. As they said in their report, "there are some upsides to global warming."

Frankly, I saw this coming. I knew that things were going to get warmer and you know what they say about a crisis: It's also an opportunity.

I live in a beautiful place. Rolling hills. Good for apple trees. But I decided to diversify. Right next to the apples, I planted peach, apricot, and plum trees. Years ago. As I say, I saw this coming. These trees wouldn't have survived the winters of the old pre-global warming days. But our winters are getting milder, and I'm betting my trees will do just fine. As I told the Fox News people: "This farm here has been set up for the future." It's not easy running a farm these days, and if the weather decides to cooperate a little bit, who am I to argue? I'm sorry for those folks who are hurt by all this, but I've got to think of my family.

Roman Abramovich

Sibneft Oil Co., Russia

Recently, there have been a lot of articles wondering whether or not global warming will be "good for Russia." As far as I'm concerned this is a dumb question. Like anything, it will be good for some people and bad for some people. But I am doing everything that I can to make sure that I am one of the people to benefit from global warming.

It's simple: As temperatures rise every year, ice will melt and huge new areas will be open for oil and gas exploration in the Arctic. And as one of Russia's wealthiest men, and head of a large oil and gas company, this is the chance of a lifetime. Researchers tell us that one quarter of the earth's untapped fossil fuels, including 375 billion barrels of oil, lie beneath the Arctic. In the industry, we're talking about this opportunity as the new "black gold rush." Already our competitors in Norway, Statoil, are working on project Snow White, which will generate an estimated \$70 billion in liquefied natural gas over the next 30 years. I'm not going to sit back and let the Norwegians or anyone else beat me out of this new business opportunity.

I'm sure that global warming is a bad thing for a lot of people, but I'll leave this to the politicians and scientists. I'm a good businessman — a good *oil* businessman — so it's time to get to work.

Stephanie Tumore, Greenpeace climate campaigner

I joined the environmental organization Greenpeace because I felt like I had to do something to make the world a better place. To me, it seems that climate change is the most dangerous problem facing humanity and the environment. The consequences of global warming are likely to be catastrophic, and we have to do something about it.

I've been working to save the Arctic. People think of the Arctic as just one big empty block of ice and snow. Either that, or where Santa and the elves live. But it's an amazing, unbelievable place. There are birds and fish that are found only there and a few other places. There are polar bears, musk oxen, and caribou; and in the summer, snowy owls, ducks, and swans migrate there to nest. But already Alaska's North Slope is taken over by 28 oil production plants, almost 5,000 wells, and 1,800 miles of pipes.

But unbelievably the oil companies see global warming and the melting ice as an opportunity to drill for even more oil and gas. Haven't we learned anything? Why are we going looking for more fossil fuels? The good thing is that there are more and more people who are determined to stop oil development. We've taken direct action and have confronted the oil drillers in places like the Beaufort Sea where we towed a fiberglass dome with two Greenpeace activists inside into a BP Northstar oil-drilling construction area. Two other activists unfurled a banner: "**Stop BP's Northstar, Save the Climate.**" Direct action. That's what it will take to stop these oil-drilling criminals.

Douglas Steenland

President and Chief Executive Officer

Northwest Airlines Corporation

I've been CEO — Chief Executive Officer — of Northwest Airlines since October of 2004 and have been president since 2001. I'm a businessman and a lawyer, and have been with Northwest since 1991. My job is to oversee the airline's longterm goals. Ultimately, I need to keep the company profitable for our investors and a secure and fulfilling place to work for our 31,000 employees.

I've been reading that air travel is bad for global warming. They say our jets produce a huge amount of carbon dioxide and other greenhouse gases that increase global warming. An article I read recently said that, "Flying is one of the most destructive things we can do." This researcher concluded that "the only ethical option ... is greatly to reduce the number of flights we take."

But ethics cuts two ways: Don't I have an ethical responsibility to my employees and stockholders? And that means expanding air travel, advertising low fares, and trying to get people to take vacations to far-away places like Japan and China, to keep Northwest profitable. Sure, we will try to

pollute less, but we'll leave global warming to the politicians and scientists to figure out. I'm just a businessman.

Rafael Hernandez

Immigrant rights activist, The Desert Angels, U.S-Mexico border

In 1986, I crossed the border from Mexico to the United States, looking for a better life for my family. Now, I am committed to help migrants in need. My group, Los Angeles del Disierto — The Desert Angels — patrols both sides of the Mexican-California border near San Diego. We look for lost migrants and leave water, clothing and food at key spots in the desert locations to help people on their journey.

Recently, we rescued María Guadalupe Beltrán, a 29-year-old mother of four who had been burned severely in the huge Harris Fire on the border. Her father had died in Mexico and she had returned home to attend his funeral. She was caught in the fire coming back into the United States. But after suffering terribly, Beltrán died of her injuries. Afterwards, I spoke to her husband, Rafael, who sat by her hospital bed for two weeks. He told me: "I asked the Virgin tell me whatever you want, please just don't take her. But she did. At 11 in the morning my wife went away. She died at 11." Six migrants died in the fire and eight were injured.

The Border Patrol has pushed migrants to cross in unsafe desert areas. And global warming is making these areas even more unsafe. I've read that climatologists say that these fires, just like the awful ones in Greece and Australia, are going to happen more and more as the climate shifts. So María and the other fire victims are also victims of global warming.

Rinchen Wangchuck

Snow Leopard Conservancy

Ladakh, India

When I was a boy, after school ended for the summer, I remember slipping down the glacier that stretched far down the mountains near my village in the Nubra Valley — in Ladakh, the far northern part of India. Today, that glacier is almost gone. And I am watching the glaciers of the Karakoram mountains disappear a little more every year. One study found that each year, the glaciers lost between 49 and 66 feet, and another found that since the 1960s, over 20 percent of the glaciers have disappeared. And as global warming increases, the glaciers will begin to melt faster and faster.

Glaciers are ice that has built up over thousands of years. Because it rains only two inches a year in Ladakh, we depend on the glaciers for 90 percent of our water. Farmers depend on this water to irrigate

fields, and everyone depends on it for drinking. Ladakhis in the villages have worked out a very cooperative system to share the water, but what will happen if the glaciers disappear? How will we survive?

In the rural areas of Ladakh, we have almost no cars. We pollute very little and release almost no greenhouse gases. It is unfair that the rich countries that produce so much carbon dioxide should be destroying the glaciers that we depend on to live.

Ana Silvia Jiménez,

Villahermosa, Tabasco, Mexico

In November of 2007, after a week of rains, terrible flooding hit the state of Tabasco, Mexico, where I live. My neighbors and I helped to put bags of sand to stop the water near to the river, but it didn't work, everything was covered with water. In the countryside, the water destroyed all the crops — the corn, sugar, cocoa and bananas. Cattle all throughout the state drowned. What will the farmers do to survive?

They say that over 80% of the state was flooded. A half a million people lost their homes. It's a tragedy. Most of my friends and family lost everything. They spent 20 years working, and they lost everything in 20 minutes.

When the flood hit, we had no water to drink; many people got sick.

Why did this happen? The government has allowed the rich to destroy my state. The state's land has sunk because of a century of constant extraction of oil and gas. Logging companies have deforested the state, which has led to erosion, and silt has filled rivers reducing their capacity to hold water and making floods worse.

And some people say that the climate is changing and leading to worse storms. I don't know, but I do know that the people here who suffer the most are the poor.

Moi Enomenga

Huaorani Indian, Eastern Ecuador

For years, the oil companies have invaded my people's lands and the lands of neighboring peoples — the Shuar, the Cofan, the Sequoya — in the rainforests of eastern Ecuador. First was Texaco. They left thousands of open pits that poisoned our rivers. Oil companies have spilled millions of gallons of crude oil and they continue to dump toxic chemicals into our rivers and streams. And oil development has also led to deforestation. When the oil companies build the roads, other "settlers" move in and chop down our forests and scare away our game.

With oil comes destruction. And now we learn that not only is oil development destroying our

rainforest, it is destroying the world, through carbon dioxide pollution that leads to global warming. We say, "Leave the oil in the ground." Why do rich countries come here? People from the richest and most populated countries come to the poorest to take its resources, to take and negotiate, to live their life better and leave us even poorer. But we are richer than they because we have the resources and the forest, and our calm life is better than their life in the city. We must all be concerned because this is the heart of the world and here we can breathe. ... So we as Huaorani, we ask those city people: Why do you want oil? We don't want oil.

Wangari Maathai, Green Belt Movement

Kenya

Africa is the continent that will be hit hardest by global warming. Unpredictable rains and floods, prolonged drought, crop failures, and fertile lands turned into deserts have already begun to change the face of Africa. The continent's poor and vulnerable will be hit the hardest. Already, some places in Africa are seeing temperatures rising twice as fast as world averages.

Wealthy countries will be affected, too. But for us, this is a matter of life and death. What makes this so outrageous is that our output of greenhouse gases is tiny when compared to the industrialized world's output. So the industrialized nations need to raise steady and reliable funds for the main victims of the climate crisis: the poor throughout the world.

For my part, I've been working in the Green Belt Movement for the last 30 years, since I was a young woman. We have mobilized millions of individual citizens in every country to plant trees, prevent soil loss, harvest rain water and practice less destructive forms of agriculture. We must protect the trees from the logging that is turning our continent into a desert. Our goal is to plant a billion trees. We will do our part to save the planet, but it is the rich countries that are most responsible.

Steve Tritch

President and Chief Executive Officer,

Westinghouse Electric

Before I became CEO of Westinghouse I was senior vice president for Nuclear Fuel, providing nuclear fuel products and services to nuclear power plants throughout the world. Before that, I led the merging of the former ABB nuclear businesses into Westinghouse Electric, and was senior vice president of Nuclear Services. And before that, in 1991 I became manager of the Nuclear Safety Department and in 1992 was appointed general manager of Westinghouse's Engineering Technology. Today, I belong to the American Nuclear Society and serve on the Nuclear Energy Institute's Board of Directors. I guess you could call me Mr. Nuke.

You might say that I'm a man on the hot seat these days. Not only are we running out of easy-to-find oil, but oil is blamed for global warming. Coal is an abundant source of power, but it produces even larger amounts of greenhouse gases than oil. Because I'm head-man at Westinghouse Electric, people are looking to my company for solutions. The solution is obvious: nuclear power. As I tell my employees, "What's good for the planet is good for Westinghouse."

Global warming could destroy much of life on earth. But nuclear power produces no greenhouse gases. They say nuclear power has dangers. Well, last year 5,200 Chinese coal miners died in accidents — and that's a lot more than have ever been hurt in a nuclear power accident. I see hope for the planet and Westinghouse is here to play our part.

Ken and Nancy Tamura

Hood River Valley, Oregon

Our family has owned and operated fruit orchards in Oregon's Hood River Valley since Ken's grandparents Katsusaburo — we called him Grandpa K, for short — and Michi Tamura bought land here in 1917. Our family's only "time off" was when the U.S. government locked our family in internment camps during World War II. But that's another story.

Every generation of our family has farmed this land. And then we woke up to the front-page article in this morning's *Oregonian* newspaper. It was a shocker. In fact, it scared us half to death. A study by Oregon State University found that 75% of the water during the summer months in the Upper Middle Fork of the Hood River comes from melting glaciers on Mt. Hood. And because of global warming, the glaciers are disappearing. That's *our* river. Well, we don't own it, but it's the river that irrigates our pears and cherries. Our family has grown fruit on this land since before we were born, and now they tell us that our irrigation water may be disappearing?

To tell you the truth, I'd never known that so much of the river's water in the summer came from glaciers. You see, glaciers on Mt. Hood are kind of small compared with glaciers on other mountains. The problem is that the scientists say that the glaciers have been shrinking because of global warming. I'd always thought that global warming might affect the Arctic and the polar bears, but not the Upper Middle Fork of the Hood River.

Robert Lovelace

Ardoch Algonquin Indian leader, Ontario, Canada

In mid-February 2008, I was sentenced to six months in jail and ordered to pay a \$15,000 fine. What was my “crime”? Trespassing on my own land — trying to block a uranium company, Frontenac Ventures, from prospecting on and polluting Algonquin Indian land. It began when we noticed people cutting down trees on land that we had never ceded to the Canadian government. Someone had given Frontenac a prospecting license and then they had gotten a court to issue an injunction against “trespassing.” But this is our land, and Algonquin Indians and our non-Indian supporters organized a 101 day blockade to physically stop Frontenac from destroying the land. I was arrested and now I’m a political prisoner.

Because of global warming, the nuclear power industry is claiming that they are the “clean” alternative, because nuclear power does not generate greenhouse gases like coal or oil. The price of uranium shot from \$43 a pound in 2006 to \$75 a pound by the beginning of 2008. Everyone predicts that it’s going to keep going up. Canada is already the world’s leading exporter of uranium, and our Prime Minister wants to increase exports and turn Canada into an “energy superpower.”

There is nothing good about uranium mining. Uranium mining has no record other than environmental destruction and negative health issues. Mining companies clearcut the land and destroy the earth to get at the uranium. Uranium can’t be stored safely and other uranium mines around Canada have left land polluted with heavy metals like arsenic. And nuclear power itself is not clean. Nuclear waste stays radioactive for thousands of years and no one has found a safe way to store nuclear poisons that long.

Climate Change Interviews

1. Find someone who believes that they are hurt by climate change. Who is the person? How has, or might, this individual be hurt?
2. Find someone who believes that he or she might benefit from climate change. Who is the person? How might the person benefit?
3. Find someone who is affected by climate change in a way that is similar to how you’re affected. Who is the person? How are your situations similar?
4. Find someone whose story involves a connection between water and climate change. Who is the person? What’s the connection?
5. Find someone who will have to change his or her life because of climate change. Who is the person? Why does this person have to make a life change? What might this individual do?
6. Find someone who lives on another continent than you do. How is this person affected by climate change? How is it different or similar to how you’re affected?
7. Find someone who has an idea about what should be done to deal with global warming. Who is the person? What is the person’s idea?
8. If possible, find someone here with whom you could take some joint action around global warming. Who is the person? What action might you take in common?

APPENDIX C

ECOLOGICAL FOOTPRINT / CLIMATE CHANGE ACTION PROJECT

Name: _____

Ecological Footprint / Climate Change Action Project

You took the ecological footprint quiz at myfootprint.org. This quiz estimates the size of your ecological footprint

The Ecological Footprint Quiz estimates the area of land and ocean required to support your consumption of food, goods, services, housing, and energy and assimilate your wastes. Your ecological footprint is expressed in "global hectares" (gha) or "global acres" (ga), which are standardized units that take into account the differences in biological productivity of various ecosystems impacted by your consumption activities. Your footprint is broken down into four consumption categories: carbon (home energy use and transportation), food, housing, and goods and services. Your footprint is also broken down into four ecosystem types or biomes: cropland, pastureland, forestland, and marine fisheries.

Now it is time to look at you results and what you can do to change them....

Look at the paper that says, "Reduce your Footprint"

List below two things that you already do that are listed on this sheet:

Now congratulate yourself!

Ok, next look for two things that you can improve upon or start over the next two weeks. List them below and describe how it went (easy/difficult, successful/unsuccessful). Please include detailed description.

1. _____

2. _____

Parent Signature: _____

Reduce your footprint

There are many simple ways to reduce the footprint you leave on the planet. Learn how to reduce your footprint in each consumption category-carbon, food, housing, and goods and services-but don't stop there. Amplify your impact by encouraging others to follow your lead. Engage your friends and community with local and global movements for social change, or start your own movement!

Reduce your Carbon Footprint

Use cleaner transport

- Walk, bike, or take public transit whenever possible.
- Avoid allowing your car to idle. If you'll be waiting for more than 30 seconds, turn off the engine (except in traffic). And don't take the drive-through-park the car and walk inside instead.
- Have your vehicle serviced regularly to keep the emission control systems operating at peak efficiency. Check your car's air filter monthly, and keep the tires adequately inflated to maximize gas mileage.
- Avoid short airplane trips-take a bus or train instead.

Add energy-saving features to your home

- Install compact fluorescent bulbs in all your home light fixtures-but remember, compact fluorescents contain mercury, so look for low-mercury models and be sure to dispose of old bulbs safely through your local hazardous waste program.
- Weatherproof your home. Make sure your walls and ceilings are insulated, and consider double-pane windows. Eliminate drafts with caulking, weather strips, and storm windows and doors.
- Insulate your water heater. Even better, switch to a tankless water heater, so your water will be heated only as you use it.
- Choose energy efficient appliances.

Adopt energy-saving habits

- Keep thermostat relatively low in winter and ease up on the air conditioning in summer. Clean or replace dirty air conditioner filters as recommended to keep the A/C operating at peak efficiency.

- Unplug your electronics when not in use. To make it easier, use a power strip. Even when turned off, items like your television, computer, and cellphone charger still sip power.
- Dry your clothes outside whenever possible.
- Make minimal use of power equipment when landscaping.
- Defrost your refrigerator and freezer regularly.
- Choose green electricity. Many utilities give you the option to purchase electricity generated by wind and solar power for a small rate surcharge.
- Purchase carbon offsets to make up for the energy use you can't eliminate.

Reduce your Food Footprint

- Eat more local, organic, in-season foods.
- Plant a garden-it doesn't get more local than that.
- Shop at your local farmer's market or natural foods store. Look for local, in-season foods that haven't traveled long distances to reach you.
- Choose foods with less packaging to reduce waste.
- Eat lower on the food chain-going meatless for just one meal a week can make a difference. Globally, it has been estimated that 18% of all greenhouse gas emissions are associated with meat consumption.

Reduce your Housing Footprint

Choose sustainable building materials, furnishings, and cleaning products.

- Explore green design features for your building, like passive solar heating, a rainwater catchment or grey water recycling system, and recycled materials.
- Choose efficient appliances, including low flow shower heads, faucets, and toilets.
- Choose furnishings that are second-hand, recycled, or sustainably produced.
- Plant drought tolerant plants in your garden and yard.
- Use biodegradable, non-toxic cleaning products.

Adopt water-saving habits

- Take shorter, less frequent showers-this not only saves water, but the energy necessary to heat it.
- Don't use the garbage disposal. Compost instead.
- Run the dishwasher and the laundry machine only when full.
- Wash cars rarely, or better yet, take them to a carwash. Commercial carwashes use less water per wash than home washers, and they are also required to drain used water into the sewage system, rather than storm drains, which protects aquatic life.
- Avoid hosing down or power-washing your deck, walkways, or driveway.
- Regularly look for and fix leaks.

Reduce your Goods and Services Footprint

- Buy less! Replace items only when you really need to.
- Recycle all your paper, glass, aluminum, and plastic. Don't forget electronics!
- Compost food waste for the garden. Garbage that is not contaminated with degradable (biological) waste can be more easily recycled and sorted, and doesn't produce methane gases (a significant greenhouse gas contributor) when stored in a landfill.
- Buy recycled products, particularly those labeled "post-consumer waste."

APPENDIX D

IMPACTS SURVEY

Impacts Survey

Please complete all questions below as honestly as possible.

* Required

Class Period *

- 1
- 3
- 4
- 5
- 6
- 7

Last Name *

First Name *

How often do you enjoy activities outdoors? *

1 2 3 4 5

Almost Never Daily

List some of the activities you enjoy outdoors. *

How much does the natural world influence your life? *

1 2 3 4 5

very little very much

List some of the examples you can think of from the above question. *

How often do you think about how your personal decisions impact the planet? *

1 2 3 4 5

almost never daily

Explain above answer. What kind of impacts do you think about? *

Do you feel that you know ways to lessen or improve your impact on the planet? *

1 2 3 4 5

no, none yes, I know several

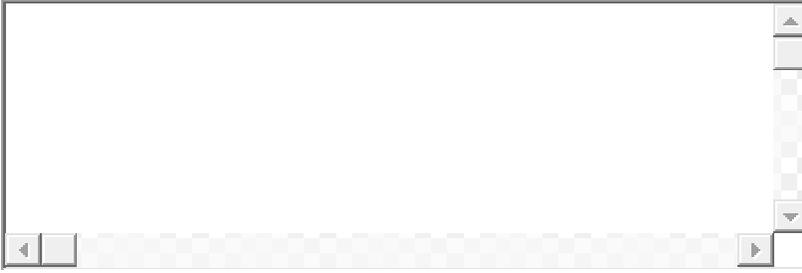
Where did you learn how to lessen or improve your impact on the planet? *

Do you implement the techniques you know of that will improve your impact on the planet? *

1 2 3 4 5

no, never yes, almost always

Please explain above answer. Can you think of some examples? *

A large empty rectangular box with a gray border and a scroll bar on the right side, intended for a user to provide an explanation and examples.

APPENDIX E

VALUES SURVEY

Values Survey

Listed below are 10 issues that we as a country and a world face. Please read all 10 statements and then rank them from 1 (the issue you are most concerned with) through 10 (the issue you are least concerned with). Each number 1 through 10 can only be used once. Thank you for your honest input.

* Required

Class Period *

- Period 1
- Period 3
- Period 4
- Period 5
- Period 6
- Period 7

First Name *

Last Name *

Improving the economy *

	1	2	3	4	5	6	7	8	9	10	
Most Concern	<input type="checkbox"/>	Least Concern									

Conserving our natural resources *

	1	2	3	4	5	6	7	8	9	10	
Most Concern	<input type="checkbox"/>	Least Concern									

Improving our education system *

	1	2	3	4	5	6	7	8	9	10	
Most Concern	<input type="checkbox"/>	Least Concern									

Improving conditions for the poor *

