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Solving Environmental Problems

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Content Objectives

Worldview is a person's belief about the purpose and function of the world. This belief is coalesced from a person's religion, shared experiences, political ideologies and their economic circumstances. Worldview affects a person's relationship with the environment and in turn their treatment of it.

Take for instance the debate between the Mirrar Clan, an indigenous people of Australia, and Energy Resources of Australia, part of a British-Australian mining company. The mining company wants to continue to mine uranium from the Kakadu region of Australia because there is a need for this ore and there are ample deposits in this area. Their decision is based on economics and politics. The Mirrar, on the other hand, have called this region their home for as long as they can remember and consider every part of the area an integral part of their spiritual development. Who's right and who's wrong (Withgott and Brennan 2007, 27)?

We know that nuclear power plants produce a great deal of power with no carbon dioxide emissions (although there are other problems associated with this energy source). The United States imports a great deal of its uranium from Australia. One of the mines from which it does is located in the Kakadu National Park, a World Heritage site. The United Nations considers this site just as universally important as the Great Barrier Reef. So, who's right and who's wrong? What should the outcome be?

At this point I could impose my worldview on the students and tell them what I think is the answer, but that isn't what I want. What I want is for the students to analyze the data, to ask "why?" until they can't ask "why?" anymore, and then formulate their own answers. After all, they will be faced with similar dilemmas throughout their adult lives.

This leads me to my second goal, which is to foster critical thinking in my students. Environmental science is the study of the natural world, how it functions, our place in it, how we impact it, and how to remediate human induced maladies. Coming up with viable solutions requires an understanding of the human dimension in the decision-making process, as well as incorporating knowledge from other disciplines into the decision-making process. For this reason history, economics, sociology, psychology, as well as other disciplines are included in the study of the environment.

The natural sciences can be used to identify problems. For example, using chemistry one can perform tests to determine water quality. If during testing high levels of nitrates and phosphates are found, one can assume that some type of excrement, in the form of fertilizer or sewage is flowing into the river. Knowledge of the businesses in the area may even lead the scientist to determine the point source for this pollution. Once the source is found, a variety of measures can be taken to stop the action, such as alternative methods of production, education, and laws. But the real question in solving the problem at its root is: "why is this 'person or business' allowing these substances to run off into the river in the first place?" Only when we understand the motivation behind the action can we hope to modify the behavior. I want the students to be able to view the problem from all angles.

Environmental science is a very broad subject. Topics include the water supply, energy issues, deforestation, soil and agriculture, and many others. Throughout all of the subcategories a few concepts are consistent (College Board 2010, 4-5):

1. Earth is a system, and an action in one part of the system will cause a reaction in another part of the system.

2. Humans have a large impact on the environment.

3. Humans rely on the environment for their survival.

4. Individual and collective interactions with the environment are determined by cultural, social, and economic influences.

The natural sciences address all of these issues. None of the solutions that science suggests can work successfully, though, until the social, economic, and political influences surrounding them are understood.

This unit seeks to engage students in using critical thinking skills to identify a problem, formulate a solution, and evaluate the solution's effectiveness.

It is designed for use with advanced environmental science students. The average class size is 18. The school requires prerequisites of biology and chemistry before taking this course. After completing it, students will sit for the national exam. I am creating this unit to be taught to the advanced Environmental Science classes at Wilbur Cross High School in New Haven. Cross is a comprehensive high school that serves approximately 1400 students from New Haven's richly diverse neighborhoods. Our mission is to promote academic excellence, social responsibility, and a love for learning that will continue for a lifetime, thereby enabling our students to become empowered citizens (Wilbur Cross High School 2011).

By the end of this unit, students will understand that solving environmental problems requires the ability to critically analyze a situation to determine its cause, that science alone cannot solve environmental problems, and that many peoples' decisions are less based on logic than on their own values. Students will therefore acquire the "habit of mind" that will assist them in solving problems they may face in the future (Llewellyn 2005).

To reach these goals my unit will focus on the following student objectives:

1. Research a country to determine its religion, culture, economy, and political structure.

2. Identify the factors that influence worldview and environmental decision-making.

3. Compare and contrast the various ideologies of environmental ethics.

4. Describe the general theories of classical and neoclassical economics and their impact on the environment.

5. Apply the various approaches to environmental policy.

6. Apply knowledge of worldviews, economic theory, and policy practices to solve an environmental problem.

Teaching Strategies

I will use a variety of instructional methods to assist students in meeting these objectives. Chief among these will be classroom discussion focused on "practicing" concepts and skills. It's a more productive use of time to have a discussion of anthropocentrism versus ecocentrism, than it is for me to lecture on it. The students will still be responsible for learning the content, but they will do it for homework, prior to the discussion. I will prepare video lectures to accompany student readings.

Case Studies

One method of instruction that I will use often, throughout the course, is case studies. There are many types of case studies. The legal field uses them, as do the medical and business fields. The purpose in each discipline is to allow students to apply the knowledge they have learned to solve a problem or to analyze a scenario. Case studies can be very elaborate, including data tables and spreadsheets, or they can be simply creatively crafted stories based on real evidence (Herreid 1997, 92-94). Case studies give students a chance to apply the content they've learned to solve a problem or answer questions.

There are many case study websites that have ready-made cases from many science disciplines. I've listed some of them in the bibliography. But following the suggestion of Dr. John Gaddis, the professor leading our seminar, I have opted to write my own case studies. At first this seems like a daunting task, but once you start writing everything fits into place. The advantages include using only the information that I want, incorporating information from other disciplines, personalizing the story so that the students can either recognize me or themselves in it, determining the length -- and it's enjoyable to share knowledge about a subject in a non-lecture situation. I've used stories that are regional to increase relevancy for students.

Objective One: Research a country to determine its religion, culture, economy, and political structure.

In order for students to be able to identify various factors, a survey of countries is necessary. Students will research their religion, culture, economics, and political structures. In groups of two, students will be assigned a specific country to investigate. The research will include two primary sources and three or more secondary sources. Time in the classroom will be dedicated to teaching research skills.

First, we will practice obtaining primary versus secondary sources. Because we are a diverse school located in a diverse neighborhood, obtaining primary sources will be fairly easy, however we will spend some of our time reviewing interviewing skills. Then we will determine credibility of Internet resources. After that, we will review MLA citation standards. Finally, we will discuss how to create an effective slide show presentation. Students will present their findings to the class as a slide show, while turning in a two-three page fully cited paper to

me. A project like this could yield a much longer paper, but I'm using this one to introduce the correct process.

The countries we will focus on are chosen for their relevance in this course and to my students personally. Students will be able to choose from India, the United States, Ethiopia, China, Indonesia, Canada, Brazil, Mexico, Puerto Rico, and France.

Students will find that in some countries many worldviews exist, which is why it is so difficult for everyone to agree on solutions. Nevertheless, there is often an unspoken identity. For example in the United States there are many ethic backgrounds, each with their own values, but one idea is fairly constant and is often the reason for immigrating here: that's the idea of "the pursuit of happiness."

Once this project is completed, students will have a more comprehensive view of the diversity of cultures, economies, and political systems that exist throughout the world.

Objective Two: Identify the factors that influence worldview and environmental decision-making.

With this broad knowledge of different cultures, students should find it easier to identify the factors that influence worldviews. They will be responsible, in groups, for identifying these. As a class we will discuss these factors and propose plausible solutions that reflect as many worldviews as possible. Students will be graded for these discussions based on quality of comments, use of evidence, and respect for others, using the rubric that I have created (see Appendix II).

Factors that shape our worldviews

Religion - Different religions relate to the environment in different ways. Some believe that the Earth should be subdued while others believe that every stone teaches a valuable lesson about living (Withgott and Brennan 2007, 29-30).

Shared experiences - Once a group of people experience the same challenges, such as harsh weather conditions, it can view these conditions as an attack on them and put the blame on "mother nature," who now becomes the enemy (Withgott and Brennan 2007, 29-30).

Political ideologies - If a person believes in a free market economy, then no type of governmental interference would be acceptable in fixing environmental problems (Withgott and Brennan 2007, 29-30). A good example of this was seen when the United States refused to sign the Kyoto Protocol.

Economics - A person's financial situation can also influence their behavior (Withgott and Brennan 2007, 29-30). Take, for instance, purchasing electricity. If a person wishes to, they can pay extra on their utility bill to have part of their electricity come from wind power. Some people do not choose this option because they believe that the few extra dollars a month are better spent on groceries.

Case Study: On the Boardwalk

"OK, everybody! I think we're all here now," said Mrs. Hernandez.

"What's on our agenda tonight? I want to get through this and go home and watch the season finale of Bones."

"The first item on the agenda is the boardwalk," said Mr. Cohen. "Many of us are concerned about the city replacing the wooden boards with concrete and we want to mount a campaign against it."

"Why would you be against it?" said Mrs. Nelson. "The boards are warped and splintering, they have to replace them. Why not with concrete? At least we'd be saving the rainforest."

"Saving the rainforest? said Mr. Powers. How does using concrete on the boardwalk save the rainforest?"

Mrs. Nelson continued, "Well, you know that the wood they use on the boardwalk is a hardwood from a rainforest tree called an ipe." "E-PAY, like Ebay." Well anyway, only one to two ipe grows every acre." "We have to save the rainforest."

"Save the rainforest, save the rainforest. What about saving my knees?" Ms. Ames said. "That concrete is a killer when I take my five mile run every morning." "One of the reasons I moved into this neighborhood was so I could run the boardwalk."

"OK, ok, everybody. Settle down," said Mrs. Hernandez. "We can't just go to the city with complaints. We have to bring them a solution. Does anybody have any solutions?"

"Well," said Mr. Cohen, "The United States has hardwood too. The city could use white oak or even black locust. Those varieties grow all over New York. We wouldn't even have to have it imported. We might even be helping a local tree farmer." "There's only one drawback, the city says that that wood isn't strong enough to withstand the weight of the trash pick-up trucks."

"You've got to be kidding me. Are we that lazy that we would sacrifice acres of rainforest just so the garbage men don't have to get out of the truck?" said Mrs. Nelson.

"No ipe, no concrete, no North American hardwoods. Are there any other options?" said Mrs. Hernandez.

"I heard the city was also considering using plastic slats," said Mrs. Nelson. "But, I'm not sure that's really an option. I mean using more petroleum can't be good either. Can it?"

"I agree with Mr. Cohen," said Mrs. Hernandez. "A boardwalk just isn't a boardwalk without boards. I was born in this neighborhood and I can remember my parents taking me down to the boardwalk in the evening for a stroll. When I go down there now the smell of the damp wood reminds me of my childhood."

"I know this sounds silly, but sometimes I go down to the boardwalk and walk barefoot," said Mr. Cohen. "All day long I struggle to makes ends meet in this concrete jungle and walking barefoot on the boardwalk is my spiritual connection to nature."

"Well, we've heard all the sides," said Mrs. Hernandez. "We have to come to a decision before we go to the city. Let's take a vote"

Task:

Identify the factors that are influencing the decisions of each person in this scenario.

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Case Study: I'll Have the Works...Without the Fire, Please.

Hector: "What are you doing?"

Julie: "Looking on online to see where the fireworks displays are."

Hector: "The 4th is over. Haven't we had enough pollution for one year?"

Julie: "Fireworks aren't pollution. They're artistic expressions of light."

Hector: "You mean light pollution."

Julie: "It's not like it's everyday."

Hector: "I read a report by the EPA that said a toxin called perchlorate which can come from fireworks is poisoning our water supply."

Julie: "What does it do to you?"

Hector: "Evidently it messes with your thyroid, and can cause growth problems."

Lucy: "Hey, guys what's going on?"

Hector: "I'm just schooling Julie about fireworks and human health."

Lucy: "Oh, you read that article about the lake study after a fireworks display?"

Hector: "No, I didn't read that one." "Tell us about it."

Lucy: "Well, this article was a scientific study that said the levels of perchlorate went up drastically within fourteen hours of the display and then they went back down." "But, they believe it settled in the soil."

Julie: "Hector, you said it can come from fireworks." Does it come from anywhere else?"

Hector: "Yeah, it can come from rocket fuel."

Julie: "See, it's not the fireworks at all." "Besides it's my right as an American to celebrate with fireworks." "The very first celebration of our independence from Britain was celebrated with fireworks."

Lucy: "What about those birds?" "Remember that big deal about all those birds dying around New Year's Day, down south?" They said that it was probably caused by the noise of the fireworks scaring the birds from their nests and them colliding into things."

Julie: "What about my right to bear arms?" "Since fireworks were originally made with gunpowder, that's gotta count." "Or, what about my right to the pursuit of happiness?"

Hector: "What about the happiness of the birds or the little kids with thyroid problems?"

Lucy: "Look, where not getting getting anywhere with this." "Let's go rent a movie, instead."

Hector: "What should we get?"

Julie: "Independence Day, of course."

Task:

Identify the factors that are influencing the decisions of each person in this scenario.

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Objective Three: Compare and contrast the various ideologies of environmental ethics.

The purpose of this section is for students to grasp the different ideologies of environmental ethics, which include anthropocentrism, biocentrism, ecocentrism, and ecofeminism. Each approaches the environment from a different vantage point.

Using the same case studies as they used for objective two, I will have students categorize each person in them as either anthropocentric, biocentric, ecocentric, or as an ecofeminist (Withgott and Brennan 2007, 32-33).

Anthropocentrism is a human centered viewpoint. People with this attitude are primarily concerned with only what benefits humans, regardless of the impact on the rest of the environment. If coal was needed to produce electricity, they would have little problem in blowing off the top of a mountain to get it.

Biocentrism focuses on the well-being of all living things, from plants to animals. This viewpoint would consider saving a mountain range for the sake of the animals that live on it, but not for the sake of the mountain itself.

Ecocentrism takes into account all biotic (living) and abiotic (nonliving) factors in the environment when making decisions. This viewpoint would see the mountain range in and of itself as reason enough not to blow it up.

Ecofeminism focuses on calling attention to the similar repressive treatment that both the environment and women receive. They believe that nature and women are viewed as submissive and something to be dominated. From this viewpoint they might demand that blowing up the mountain is an affront to all women.

Objective Four: Describe the general theories of classical and neoclassical economics and their impact on the environment.

The two theories that we focus on in environmental science are Adam Smith's "Invisible Hand" and the neoclassical theory of "supply and demand."

Adam Smith believed that when anyone acts in his or her own self interest, it will automatically also benefit the masses. (Withgott and Brennan 2007, 39-41). Whether or not divine intervention is the reason for this phenomena, it is still the theory behind a free market economy, and can be put to good use in helping the environment. For example, demand for a product or service causes other companies to invest in research and development into these areas, in hopes of producing a more coveted product and in turn obtaining a larger share of the profits. While doing this they are increasing choice, quality, and supply. When they increase supply, they decrease cost. This benefits the consumer all around.

In order for this process to work to the advantage of the environment, consumers would first have to show the companies that they really want something. Let's use electric vehicles as an example. When these were first made available to the general public, there were only a handful. After the benefits, both financial and environmental, became clearer, more and more people wanted to own an electric vehicle. This surge in interest caused many other automobile companies to design their version of the electric car to compete for sales. Now there are dozens of choices on the road, ranging from small and utilitarian like the Smart Car ED to the racy Tesla roadster. Through the invisible hand of self betterment, these companies have provided the consumer with more models and price ranges to choose from.

To drive this point home with students I will have them read the following quote by Adam Smith, summarize what it means, and have them give some modern day examples. Once we've discussed these, I will ask students to show how Smith's theory could be used and what obstacles stand in the way.

"By preferring the support of domestic to that of foreign industry, he intends only his own security; and by directing that industry in such a manner as its produce may be of the greatest value, he intends only his own gain; and he is in this, as in many other cases, led by an invisible hand to promote an end which was no part of his intention. Nor is it always the worse for the society that it was no part of it. By pursuing his own interest, he frequently promotes that of the society more effectually than when he really intends to promote it. (Smith 1776)"

In the second part of objective three, we will focus on supply and demand. This neoclassical idea simply states that when the price of a good increases, the demand for that good will decrease. In this inverse relationship the opposite can be said: when the price of a good decreases the demand for the good will increase. Supply and demand will go back and forth until an equilibrium is reached (Withgott and Brennan 2007, 41-42). When something is in short supply, it's worth more. Take, for instance, athletes' salaries. Of particular note is Alex Rodriguez (A Rod), who in 2008 earned the highest salary of all athletes; $29,000,000 a year. This figure is just salary, not endorsements (Freedman). What made Alex Rodriguez worth so much is that he had talents that were rare and in short supply, which drove up his worth.

In class I will use an activity to practice this concept. I will bring in an item that I've created and ask students

to tell me how much they would pay for it. I will ask each of them to write down their answers anonymously to limit social pressures. I will tally up the results and write them into a data table on the board. The students will then graph the data. They will then analyze it to determine the equilibrium or price that will make the most money.

At this point the students understand supply and demand. Now I will ask them to apply it to a real life scenario.

Case Study: The Long Wharf Nature Preserve

The State of Connecticut wants to take a third of the preserve to use to expand interstate 95. The purpose of the expansion is to relieve congestion on this roadway. With Connecticut and especially I-95 being the primary gateway between Boston and New York, you can imagine that the traffic gets a little heavy. Combine this with the daily commuting traffic and rush hour is unbearable.

What I want the students to do at this point is to apply the theory of supply and demand to this situation to develop an alternate solution to destroying the preserve.

There is no single answer, but what I'd like to see is a discussion of gas prices and how increasing them would decrease the traffic and encourage commuters to either use public transportation or carpool.

Task:

Use the theory of supply and demand to formulate possible solutions to this problem.

References:

Levitt, Steven D. Hurray for High Gas Prices. Freakanomics, June 18, 2007. Accessed 6/30/11. http://www.freakonomics.com/2007/06/18/hurray-for-high-gas-prices/

Objective Five: Apply the various approaches to environmental policy.

To accomplish this objective, students will be broken into groups. Each will be given the same case study, but asked to use a different environmental policy approach to solve the problem: green taxes, subsidies, command and control, and market permits. These approaches are usually used by governments, but I will allow them to be creative with their solutions (Withgott and Brennan 2007, 70-75).

Green Taxes: This is a penalty for choosing an option that isn't good for the environment. For example the deposit on soda and water bottles could be considered a green tax. The deposit was created to encourage people to recycle, thereby getting their money back. If a person chooses not to recycle, they are penalized by losing the deposit amount.

Subsidies: In this approach the government pays people to do something, like encouraging farmers to grow specific crops.

Command and control: This method is simply enacting a law and promising punishment if it's broken. The problem with this is enforcement: if it isn't enforced consistently it won't be taken seriously.

Market Permits: In this approach the government sets a limit of how much pollution can be allowed, and then

sells or gives permission tickets to pollute. The incentive here is that if a polluter doesn't use all of its permits, it can sell them to someone else and make a profit. Every year the amount of allowable pollution would be reduced, making tickets scare and more expensive, hopefully encouraging environmentally friendly changes.

Case Study: Paper or Plastic? or Jellyfish?

Problem: Sea turtles are mistaking plastic bags for jellyfish.

Background:

The leatherback is the largest species of sea turtle. It can grow up to eight feet long and weigh up to 2000 pounds. That's the size of a Smart Car. They get their name from the rubber-like skin that covers their shell. The primary diet of the leatherback is jellyfish. So, as you can imagine, as the jellyfish migrate, so does the leatherback right after them. The habitat of the leatherback turtle spans the world's oceans, from the Pacific to the Indian to the Atlantic. They can even be spotted off the coast of Connecticut. The leatherback is an endangered species worldwide. This is largely due to destruction of nesting sites.

The leatherback has an average lifespan of 50 years. Every female can produce over 5,000 hatchlings in a lifetime. This sounds like a lot, but only five make it to adulthood.

Although necropsy reports do not confirm plastic as the cause of premature death in all cases, it is indicated that the plastic blocks the gastrointestinal track. Blocking the track at the very minimum prevents nutrients from being properly absorbed. The turtle in turn dies from malnutrition.

Plastic shopping bags are a mainstream commodity. They're used in most retail stores, from grocery to clothes. It's been estimated that more than five billion plastic bags are used each year worldwide and millions of those don't wind up in the landfill. Traditional grocery style plastic bags or t-shirt style as they're called cost the retailer about $0.04 each. Grocery quality paper bags are about $0.07 each . Biodegradable alternatives are about $0.16 each .

Task:

Use one environmental policy approach to limit the use of plastic bags.

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Objective Six: Apply knowledge of worldviews, economic theory, and policy practices to solve an environmental problem.

To meet this last objective students will use their knowledge of worldviews to analyze Tragedy of the Commons, written in 1968 by Garrett Hardin. Their job is to identify the social, economic, and political implications of this paper and determine its plausibility in the 21st century. Students will be asked to write a persuasive essay in favor or not of this paper. This paper is the culminating project for the unit.

Resources

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U.S. Fish and Wildlife Service. North Florida Ecological Services Office. Leatherback Sea Turtle. January 19, 2011. Accessed 7/1/11. http://www.fws.gov/northflorida/SeaTurtles/Turtle%20Factsheets/leatherback-sea-turtle.htm

Fact sheet on leatherback turtles.

Uline Shipping Supply Specialist. Grocery Bags. Accessed 7/2/11. http://www.uline.com/BL_5504/Grocery-Bags

Source to price paper bags.

Universal Plastic. T-Shirts Bags. Accessed 7/2/11. http://www.universalplastic.com/prod/T-Shirts-Bags.php

Source to price plastic bags.

Weise, Elizabeth. "Fireworks likely cause of massive Ark. bird kill." USA Today, January 5, 2011. Accessed 7/4/11. http://www.usatoday.com/news/nation/2011-01-05-arkansas-dead-birds-fireworks_N.htm

Newspaper article detailing the massive bird die offs.

Wilbur Cross High School. Mission Statement. 2011. http://www.nhps.net/wilburcross. Accessed 7/1/11.

Wilbur Cross High School website.

Wilken, Richard T., Dennis Fine, and Nicole Burnett. "Perchlorate Behavior in a Municipal Lake Following Fireworks Displays." Journal of Environmental Science and Technology, 2007, 4 3966-3971.

Field study paper on perchlorate.

Withgott, Jay, and Scott Brennan. Environment: The Science behind the Stories, 2 n d ed. San Francisco: Pearson Education, Inc, 2007.

College level textbook that covers environmental science.

Teacher Reading List

Brower, Michael and Warren Leon. The Consumer's Guide to Effective Environmental Choices: Practical Advice from the Union of Concerned Scientists. New York: Three Rivers Press, 1999.

Down to earth guide to help the average citizens make environmentally friendly choices.

Colorado Internet Center for Environmental Problem Solving (The). http://www.colorado.edu/conflict/environment/gceqsearch.htm . Accessed 5/28/11.

Site includes methods and case studies in environmental problem solving.

Ehrlich, Paul R. and Anne H. Ehrlich. Healing the Planet, Strategies for Resolving the Environmenal Crisis. Reading: Addison-Wesley, 1991.

An evidence based discussion of the problems humans face, with some practical solutions.

Gaddis, John. The Landscape of History. New York: Oxford University Press, 2004.

An in depth look at the scientific method of writing history.

Gibbs, Lois Marie and Murray Levine. Love Canal, My Story. New York: Grove Press, 1982.

Personal story about the experiences of being involved in the Love Canal.

Gore, Al. Earth in the Balance, Ecology and the Human Spirit. New York: Penguin Group, 1993.

A review of the environmental problems that humans face, with some solutions.

McNeill, J.R., and William McNeill. The Human Web, A Bird's-Eye View of World History. New York: W. W. Norton & Company, 2003.

A concise history of world civilization.

Merchant, Carolyn. Major Problems in American Environmental History. Lexington: D. C. Heath and Company, 1993.

A systematic look at environmental problems throughout American history.

National Center for Case Study Teaching in Science. Accessed 6/24/11. http://sciencecases.lib.buffalo.edu/cs/

Excellent resource for case studies and learning how to write and use case studies in science.

Pierce, Christine and Donald VanDeVeer, edit. People, Penguins, and Plastic Trees, 2nd edition. Belmont: Wadsworth Publishing Company, 1995.

A compilation of essays on environmental ethics by many influential authors.

Roszak, Theodore, Mary E. Gomes, and Allen D. Kanner, edit. Ecopsychology, Restoring the Earth, Healing the Mind. San Francisco: Sierra Club Books, 1995.

A collection of essays dealing with the psychological side of environmental treatment.

Sebranek, Patrick, Dave Kemper, and Verne Meyer. Writers Inc. Wilmington: Great Source Education Group, 2001.

This resource teaches students how to write just about anything. Although it's written for students it serves as a useful guide for teachers.

Student Reading List

Henderson, David. Demand. Library of economics and Liberty, 2008. Accessed 6/30/11. http://www.econlib.org/library/Enc/Demand.html

Online economic encyclopedia.

Kovarik, William. Environmental History Timeline. Accessed 5/24/11. http://www.radford.edu/~wkovarik/envhist/

Online environmental history with links to more in depth information.

Oracle Thinkquest. March 2005. Accessed 6/23/11. http://library.thinkquest.org/04oct/01590/humans/enviroworldview.html

Online resource discussing the various worldviews.

United States Energy Information Administration. Accessed 7/1/11. http://www.eia.gov/kids/energy.cfm?page=nuclear_home

Online resource for energy use in the United States.

Materials List

Copies of case studies.

Appendix I: Implementing District Standards: New Haven

DINQ5 Identify independent and dependent variables, including those that are kept constant and those used as controls.

Throughout all case studies students are asked to identify the factors that influence decision-making, this is excellent practice for isolating variables.

DINQ7 Assess the reliability of the data that was generated in the investigation.

This standard is addressed early on in the unit by having students determine credibility of resources while researching.

DINQ8 Use mathematical operations to analyze and interpret data, and present relationships between variables in appropriate forms.

This standard is met in the supply and demand lesson where students have to create a graph and determine costs of goods.

DINQ10 Communicate about science in different formats, using relevant science vocabulary, supporting evidence and clear logic.

The unit clearly meets this standard by having students communicate in writing, slide show presentations, and discussions.

Appendix II

Discussion Rubric			
	3	**2**	**1**
Quality of Comments	Comments are appropriate and well constructed.	Comments are thoughtful, but sometimes off topic.	Does not participate or comments are inappropriate.
Use of Evidence	Comments are fully support by evidence.	Comments are often not supported by evidence.	No evidence is used when making comments.
Debate Decorum	Actively listening to others and respectful their comments.	Listens to others, but may interrupt to interject own comments.	Obviously not listening or judgmental in responses.