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What's Your Green Bottom Line? The Truth About What We Leave Behind

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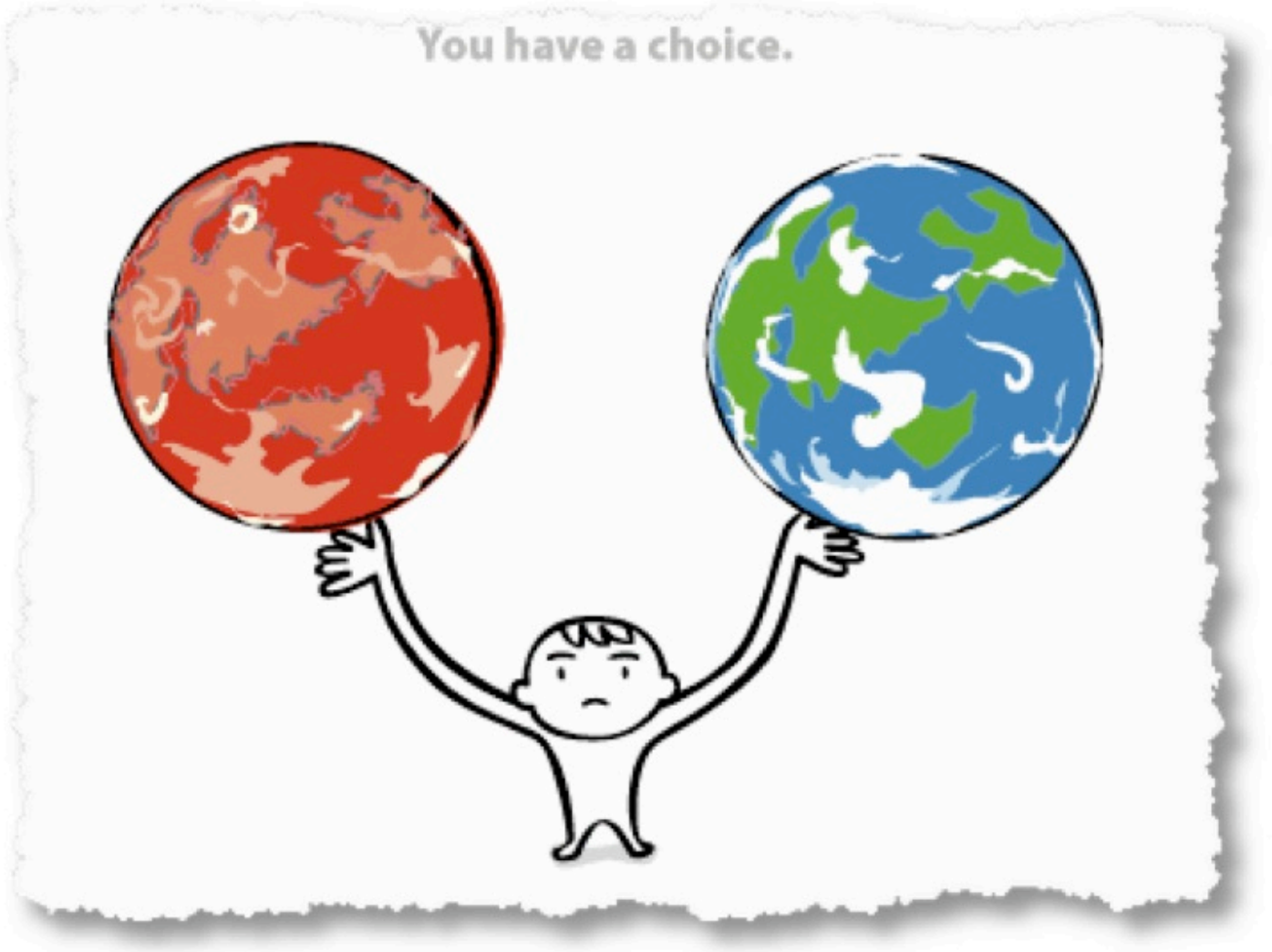
Introduction

> And man created the plastic bag, the tin and aluminum can, the cellophane wrapper and the paper plate. And this was good because man could then take his automobile and buy all his food in one place and he could save that which was good to eat in the refrigerator and throw away that which had no further use. And soon the Earth was covered with plastic bags and aluminum cans and paper plates and disposable bottles and there was nowhere to sit down or walk, and man shook his head and cried, "Look at this Godawful mess. ~Art Buchwald…1970



On Earth, we are lucky enough to have an atmosphere with constantly changing weather. The average pattern of weather over a large region, called climate, usually stays pretty much the same for centuries and will cycle in normal patterns as long as it is left alone. However, the Earth is not being left alone. Human choices are changing the planet, especially its climate, significantly. It is safe to say that the human activity that is most likely to have a large impact on the climate is the burning of fossil fuels that contain carbon (such as coal, oil and gas). Burning of these fossil fuels makes carbon dioxide gas, which is colorless and odorless. Our growing population and poor choices, sometimes due to mere lack of knowledge, have caused carbon dioxide gas to be added to the Earth's atmosphere at an alarming rate. According to the United States Department of Energy, "Fossil fuels currently represent over 85% of all energy consumption in the United States." In other words, people use fossil fuels more than any other source of energy and for more purposes than sustainable power sources can currently accommodate! Specifically, "since 1751, approximately 329 billion tons of carbon have been released to the atmosphere from the consumption of fossil fuels and cement production. Half of these emissions have occurred since the mid 1970s. The 2006 global fossil fuel carbon emission estimate of 8,230 million metric tons of carbon represents an all-time high and a 3.2% increase from 2005" (Carbon Dioxide Information Analysis Center [1]). The National Environmental Indicator Series Archives Website of Canada [2] reports that the carbon dioxide emissions from fossil fuel use gross world product is over 25 trillion dollars! This rampant use of fossil fuels has caused climate change to become a major concern facing our planet. Walt Kelly's 1971 Earth Day poster, shown below (Figure 1 permission courtesy of Okefenokee Glee & Perloo, Inc.), famously sums up why this is happening, as character Pogo states, "We have met the enemy and

he is us."

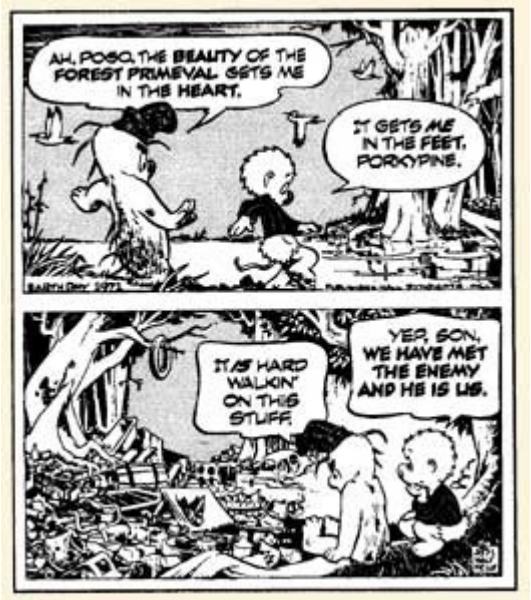


Figure 1

Unfortunately, even with statistical data as proof, I've found that many people, especially my high school students, don't really care about this issue. Maybe they don't take interest because they can't see it or they don't feel any personal connection to it. If only the effects of climate change were as obvious as those from acid rain or eating too many donuts, we might turn the lights off or recycle more often at home. Because, if the average temperature continues to rise, rain and snow patterns will change, the length of growing seasons will be altered, the frequency and severity of storms will increase, and sea level will rise. Farms, forests, plants and animals in the natural environment will be altered. In short, all humans will be affected to some degree, now and in the future.

My goal for this curriculum unit is to help my students understand that simple, daily shifts of habit can have a positive impact on the planet, while also entailing personal gain, specifically regarding their time and money (2 important factors in their lives). Any habit that can save them money, time and the planet is a win-win situation to me! I teach regular and honors Earth and Environmental Science courses that are a semester (2 quarters) in length. My students are mostly 9 th graders, although I do have the occasional upperclassman that has either failed it the first time or has simply waited to take it. This unit will be taught during the beginning of the course, particularly as an introduction to the environmental studies section (includes North Carolina state standards [3]) and will run approximately 2 weeks long. The main objective is to change the way students think about the environment by making greener choices; however, emphasis will be placed on 2 of the 12 principals of green chemistry and a case study of plastics.

One part of making greener choices on an individual daily basis means choosing to purchase products that are recyclable, or better yet, reusable, so there will be less waste and a higher monetary savings long-term. My students will learn what their carbon footprint is (calculation of how much greenhouse gas emissions are causing climate change). They will explore the chemical make-up of plastic, the waste accumulated by it, and its harmful effects on the environment and the human body. Discussions surrounding 2 green chemistry principals (in particular #1: It is better to prevent waste than to treat or clean up waste after it is formed; and #10: Chemical products should be designed so that at the end of their function they do not persist in the

environment and break down into innocuous degradation products) in conjunction with local (Charlotte, North Carolina) environmental justice issues will lead my students to a realization that taking care of the Earth is much more important and personal than they originally thought. Everyday actions do effect the environment and by making simple changes, they CAN make a difference and sustain their environment.

Objectives

Overview

Some of the greatest threats to future resources come from the things we throw away everyday. Throwing away items that could be recycled diminishes energy, water and natural resources that could be saved by recycling or reusing.

Fossil fuels present a challenge to the pursuit of a completely sustainable and "green" energy policy. While moving to sustainable fuels is an important step in combating the energy crisis, fossil fuels will continue to be a necessary part of people's lives around the world. So what can we do as individuals to help extend our current supply of fuel while sustainable power catches up? How can we increase the advocacy of a sustainable society when most people are habitual and already "set in their ways"? These are the main objectives I would like to explore throughout this unit, What's Your Green Bottom Line? The Truth About What We Leave Behind. I would like to see my students shift their focus away from the cheap and disposable and towards more high quality products that are built to last and that create little or no waste. High quality, long-lasting products cost a bit more up-front, but they'll save money in the long run.

Rationale

Approximately 35 people move to Charlotte every day. The district that I teach in, Charlotte-Mecklenburg Schools (CMS), grows by approximately 4,000 students per year! We are one of the largest school districts in the nation! My school is one of 173 in the CMS District that encompasses more than 133,000 students in grades K-12. They come from all different ethnic backgrounds, all different types of families, and are at all different levels of physical and academic ability. Nearly half of the students in the district qualify for free or reduced lunch, which is the federal standard for measuring poverty. We are home to students who are from 151 countries, and speak 120 different languages. According to my district's website, approximately 42% are African-American, 35% are Caucasian/White, 15% are Hispanic/Latino, 4% are Asian-American, and 4% are American Indian/Multiracial (Charlotte Mecklenburg Schools [4]). These statistics only reflect the tip of the iceberg when it comes to diversity, as each of those groups contains many socioeconomic, cultural, ethnic, special-needs and religious subgroups.

I teach regular and honors Earth and Environmental Science at East Mecklenburg High School in Charlotte, North Carolina. At East, my classroom is quite diverse not only because of my students' demographics, but also in age and academic ability. Most students follow a block schedule consisting of four 90-minute classes. Even as a 7 th year teacher, at times I struggle to hold my students' attention for that amount of time. In addition, when it comes for the environmental studies section of my course, I often find students already know the basics of recycling and caring for the planet, and they don't really want to learn anything more. They do not even practice what they already know!

Albert Einstein once said, "Education is what remains after one has forgotten everything he learned in school." My high school students might forget the detailed facts about climate change and plastics sooner or later; however, it is my hope, as I introduce powerful issues regarding the world of environmental climate justice, that this new knowledge will last a lifetime.

Climate change, also commonly classified nowadays as global warming, is not the only environmental issue of importance, but it definitely has become somewhat of a celebrity amongst its counterparts, probably thanks to Al Gore's 2006 documentary film, An Inconvenient Truth: A Global Warning. Even Robert Redford will be screening seven environmentally themed films at his Sundance Film Festival as part of the large program of films this year! I believe the reason we are seeing so much "green" on the screen, is because, climate change affects us in so many ways, not just with weather. It affects us culturally, socially and economically according to internationally acclaimed scientist, explorer, conservationist and Australian, Tim Flannery (2005 [5]). Even though all the hype about "going green" has been out for a while, I've noticed many people, especially my high school students, have been impervious to it and have continued their excessive standard of living. I believe our younger generations should be extremely conscious of how their daily habits effect the environment. I would like to change their way of thinking. President and CEO of the World Wildlife Fund in Canada, Mike Russill, said that, "To win (against global warming) will take vision and courage, small steps and giant strides by businesses, governments and individuals. Each must believe that the fight is winnable...and that we do not have to dramatically change the way we live!" (Noble 2007 [6])

While it's easy to get overwhelmed with thinking "green", it's also simple to begin making a positive impact. I showed the movie, The Day After Tomorrow, (2004 film looking at what the world would look like if the greenhouse effect and global warming continued at such levels that they resulted in worldwide catastrophe and disaster; including multiple hurricanes, tornadoes, tidal waves, floods and the beginning of the next Ice Age) to my Earth and Environmental Science class and posed the post-viewing discussion question: "Do you think this type of film could scare people into at least thinking about the environment or the issue of global warming and then actually doing something about it?" The answers I received were astonishing:

- "I know global warming is bad, but nobody cares about what they do. If I didn't live in a city, maybe I would learn how to save electricity and stuff more. Most kids only think about themselves and want to follow the people on TV and if Lil'Wayne ain't doing it, neither are they."
- "When it comes to the environment, doing something about it is optional. People won't take it seriously because there are no laws stating they have to recycle and stuff like that."
- "Some people could care less about the things that are occurring, all they want to do is just live life and live lazy 'cause it's easier. Recycling doesn't cost any money and it is very easy, but they still don't do it, maybe they think there is no way all of us could destroy a planet this big."
- "If the government offered incentives maybe more people would be more willing to recycle because not everyone listens to commercials and programs about saving the Earth. We hear it all the time, but we think it's not for us."
- "I think one way to make lazy people recycle and stuff is to show them what could happen if we don't."

All my students are aware of the current campaign for a greener environment. However, the vast majority of them just aren't concerned with making necessary changes to live a greener lifestyle. I know what my green bottom line is, and its not that great, despite the knowledge I have. So how can I change the habits of a much younger, more eccentric-alternative generation if it's hard for me sometimes?

With a million green messages and ideas coming at us from all sides - in the news, politics, technology, even

fashion, it can be easy to get caught up in the run of the mill lifestyle changes - turning down the thermostat, carpooling, turning the water off when brushing your teeth, recycling…without thinking about the big picture of whether your actions are truly worthwhile. You might even be suffering from a little green fatigue, and tuning out the green messages because they are so ubiquitous. As mentioned before, it is easy to get overwhelmed, so it will be helpful to understand the big picture when it comes to setting smaller personal goals.

So here it is, the BIG picture. According to the U.S. Census Bureau the world population is expanding at a mind-boggling rate. I display a surprising graph to my students that shows the world reached 1 billion people in the year 1800; 2 billion by 1922; and over 6 billion by 2000. It is estimated that the population will swell to over 9 billion by 2050. That means that if the world's natural resources were evenly distributed, people in 2050 will only have 25% of the resources per capita that people in 1950 had (United States Census Bureau [7]).

"What do I care?" yells a student in my class.

"Yeah, it's not my problem!" shouts another in response.

I go on to explain that the world has a fixed amount of natural resources - some of which are already depleted. The more people we have on Earth, the more resources we are using up and the fewer we will have available in the future. Usually the same students shout out their previous comments. Then I ask them if they intend to get married and have children, maybe even grandchildren one day. Now their interest has been sparked…its gotten personal. So, I continue to state that if we intend to leave our children and grandchildren with the same standard of living we have enjoyed, we must preserve the foundation of that standard of living. I really perk their interest when I bring money into the conversation.

I'll ask, "How many of you save your money to buy clothes, jewelry, food, phones, and iPods ?" Pretty much the entire class raises their hands.

"But what about saving clean air, water, fuel sources and soil for future generations? Do you save for that?" All hands are down.

Here is where my conversation must shift from its original script because at almost an instant, by speaking about saving the planet, I've lost their attention again. I will need to share pertinent, real-life proof of the damage that is done by living conveniently.

As WE burn more fossil fuel for energy, WE add more carbon dioxide to the atmosphere due to the presence of certain "greenhouse gases" that trap heat, like carbon dioxide, methane, water vapor, and chlorofluorocarbons (CFC's). The Earth's atmosphere retains the sun's radiation and warms up the planet. By increasing the abundance of these gases in the atmosphere, humankind is increasing the overall warming of the Earth's surface and the lower atmosphere, a process called "global warming". How do we know for sure? The rise of carbon dioxide in the atmosphere is readily documented by direct measurements (i.e. the "Keeling" curve - which depicts the inexorable rise of carbon dioxide in the atmosphere since 1957, with its annual variations superimposed on the accelerating trend of increase) and by the results of ice core studies from the polar-regions (University of California at San Diego [8]).

WHO is climate change affecting the most? If I want to make my students truly understand this issue, I've got to not only have them explore the proof, but also make it personal. Global warming, or climate change, is fundamentally an issue of human rights and environmental justice. According to the Environmental Justice and

Climate Change (EJCC) Website [9] , human lives, particularly in people of color, low-income, and indigenous communities, are affected by compromised health, financial burdens, and social and cultural disruptions. These communities are the first to experience the negative impacts of climate change such as heat-related illness and death, respiratory illness, infectious diseases, unaffordable rises in energy costs, and extreme natural disasters.

The EJCC is a diverse coalition of advocacy networks working for climate justice. Climate justice is a form of environmental justice, and is the fair treatment of all people and freedom from discrimination with the creation of policies and projects that address climate change and the systems that create climate change and perpetuate discrimination (EJCC). Through this initiative and ones similar to it, my students will be connected with thousands of people in communities, just like theirs, across the country and learn about not only the effects of climate change and environmental injustice, but also the vision to dissolve and alleviate the unequal burdens created by climate change. They will be empowered in the classroom in hopes that they will become active for change in their community.

Background Information

Chemistry is called the "central science" because it is in EVERYTHING we use! Green chemistry, also known as sustainable chemistry, is the design of chemical products and processes that reduce or eliminate the use or generation of hazardous substances. Green chemistry applies across the life cycle, including the design, manufacture, and use of a chemical product (United States Environmental Protection Agency [10]). In short, it is a totally efficient, benign chemistry practice. Paul Anastas is known as the "Father of Green Chemistry". Recently, President Barack Obama confirmed the appointment of Anastas to be the Assistant Administrator for Office of Research and Development with the Environmental Protection Agency (The White House [11]). I am positive with Anastas in such a vital role, he will lead the government and the president on a much "greener" track with regards to changing our environmental future. This means businesses will eventually have to adhere to his green chemistry principles and individuals will need to make greener choices everyday. It will be a great and necessary collaboration.

Anastas said, "Climate change is energy, energy is water, water is chemistry. Everything that you touch breathe, drink, eat… is CHEMISTRY!" He also empathetically stated, "Many people have been doing the right things wrong," such as purifying water with acutely lethal substances; precious rare toxic metals used in photovoltaic cells; agricultural crop efficiency from persistent pesticides; compact fluorescent bulbs based on mercury; and electricity and power from fossil fuel plants. He goes on to say that, "As we (chemists especially) accumulate more knowledge, we adjust our processes and we can't pretend we don't have the knowledge." What Anastas means is once we have gained new knowledge (about chemistry especially), we shouldn't be making the same mistakes and poor choices with it time and again. We have far more knowledge on how to design products on a molecular level that are far better than what we've done in the past.

Green Chemistry is a highly effective approach to pollution prevention because it applies innovative scientific solutions to real-world environmental situations. The 12 Principles of Green Chemistry provide a road map for chemists to implement green chemistry. They are:

1. It is better to prevent waste than to treat or clean up waste after it is formed.
2. Synthetic methods should be designed to maximize the incorporation of all materials used in the process into the final product.
3. Wherever practicable, synthetic methodologies should be designed to use and generate substances that

possess little or no toxicity to human health and the environment.

4. Chemical products should be designed to preserve efficacy of function while reducing toxicity.
5. The use of auxiliary substances (i.e. solvents, separation agents, etc.) should be made unnecessary wherever possible and, innocuous when used.
6. Energy requirements should be recognized for their environmental and economic impacts and should be minimized. Synthetic methods should be conducted at ambient temperature and pressure.
7. A raw material of feedstock should be renewable rather than depleting wherever technically and economically practicable.
8. Unnecessary derivatization (blocking group, protection/deprotection, temporary modification of physical/chemical processes) should be avoided whenever possible.
9. Catalytic reagents (as selective as possible) are superior to stoichiometric reagents.
10. Chemical products should be designed so that at the end of their function they do not persist in the environment and break down into innocuous degradation products.
11. Analytical methodologies need to be further developed to allow for real-time, in-process monitoring and control prior to the formation of hazardous substances.
12. Substances and the form of a substance used in a chemical process should be chosen so as to minimize the potential for chemical accidents, including releases, explosions, and fires.

This unit will focus on just 2 of the 12 green chemistry principals. The first is #1: It is better to prevent waste than to treat or clean up waste after it is formed. When manufacturing and using chemicals, it is expected that there are standard costs involved. However, the cost of treatment and disposal of chemical substances has increased substantially (Anastas and Warner 1998, 31 [12]). The only way to prevent continual increases in costs is to "avoid the use or generation of hazardous substances by designing chemistry through the use of green chemistry techniques" (Anastas and Warner 1998, 31). In summation, preventing a problem is superior to trying to solve the problem once it has been created.

The second green chemistry principle this unit will focus on is #10: Chemical products should be designed so that at the end of their function they do not persist in the environment and break down into innocuous degradation products. A major concern with some chemicals is that they are persistent. Meaning, once they are released in to the environment, they remain in the same form. They can also be taken up into various plant and animal species and accumulate in their systems (Anastas and Warner 1998, 51). This is called bioaccumulation and is often harmful to the species.

With regards to the issue of persistent bioaccumulators, the green chemistry considerations would be to address the disposition of the substance after its function is completed as well as designing the substance to achieve its primary function (Anastas and Warner 1998, 52). For example, a plastic garbage bag needs to be designed so that it does not remain a plastic bag after it is used and thrown away or recycled.

Plastics are known for their durability and long life. The problem with plastics is that their chemical and physical characteristics are cause for concern in the environment. An initial issue was with wildlife ingesting indigestible plastics or getting caught in pieces of plastic and dying. This resulted in an effort to develop a biodegradable plastic (will break down in the environment). Anastas and Warner state that in designing a chemical for biodegradability, the parent product must be assessed to determine what it will break down into. They go on to say that it is possible to place features and functional groups in the molecular structure of a chemical product that will facilitate its disassembly (1998). In addition, the degradation products themselves may possess toxicity or other hazards that must be assessed. So just as with any other green chemistry process, the process to make biodegradable products should include the effects on human health,

ecosystems, wildlife, and the overall pollution load (Anastas and Warner 1998, 53).

According to the Sustainweb Web site [13] the best way to reduce the environmental damage caused by plastics, or any sort of waste, is to follow the rule: reduce, reuse and recycle. So when it comes to plastic (water or juice) bottles (a product my students use everyday), although it is possible to make biodegradable plastics, recycle certain plastics, and even reuse them, by far the best option is not to have a bottle at all. This means using tap water in a reusable bottle. Tap water easily wins the battle with bottled water; there is no plastic waste to burn, bury or turn into other consumer goods, using more energy! The Sustainweb Web site also states that despite bottled water costing around 500 times as much as tap water, analysts predict we will buy more than 2 billion liters this year. And, when it comes to transporting water, the Chartered Institution of Water and Environmental Management [14] has pointed out the substantial fuel costs, and thousands of tons of harmful emissions involved in transferring over 22 million tons of bottled liquid from country to country every year. On the other hand, tap water is relatively efficient in comparison as its underground infrastructure of pipes and plumbing uses significantly less energy than shipping and trucking bottles around the world.

In addition, Waste Management [15] reports that Americans discard 38 billion plastic water bottles every year and that we produce enough plastic film in the United States to shrink-wrap Texas! Why so much consumption? Plastic is easy to work with, it's lightweight, flexible, economical, has high strength, low friction, no electrical conductivity, no maintenance and is extremely accessible in stores. The problems with plastic are that manufacturing it is resource intensive, it's made from non-renewable resources (fossil fuels) and it "never" biodegrades. It's also a source of the CO_2 emissions in our atmosphere that contribute to global warming. Waste Management reports that it takes more than 1.5 million barrels of oil to produce a year's supply of water bottles. That's enough oil to fuel 100,000 cars for a year. In short, yes, we'll run out of oil eventually, but we'll always have our plastic garbage!

Types of Plastic

Plastics come in a variety of colors and chemical formulations, all with different recycling needs. So how can you tell whether to put a plastic container into your recycling bin? Turn the product over and look for the recycling symbol, a triangle with a number from 1 to 7 inside (see Figure 2 below).

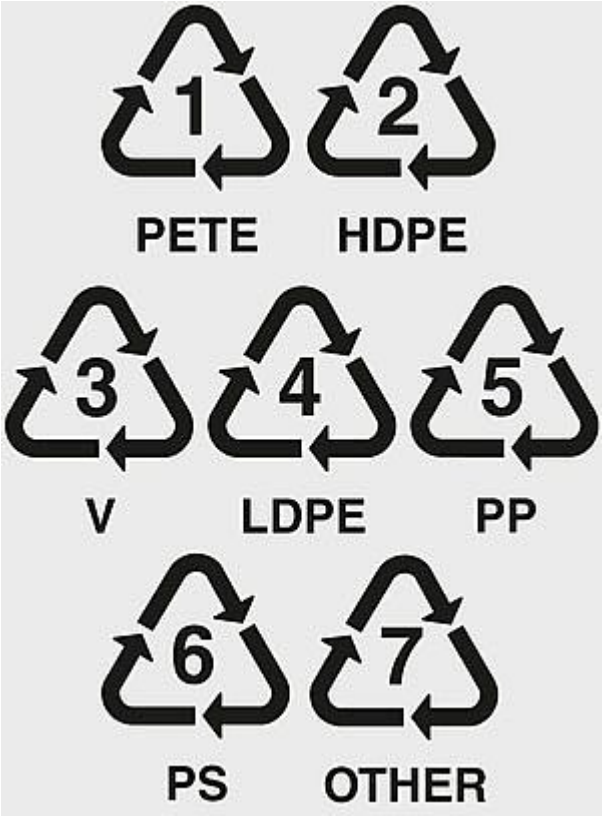


Figure 2

The number that you'll find is the "resin identification code," or RIC. It is used by the plastic industry for promotional reasons. The number identifies the molecule shape; it is the code of what type of plastic it's made of. It does not mean the item can be recycled, only that each number represents a different type of plastic, and some are more easily recycled than others. There are hundreds of different types and molds of plastics. As of right now, we can only recycle a few types of plastic! It can be misleading and frustrating to see the recycling symbol on a plastic container that cannot be recycled. Some municipalities accept all types of plastic. Others accept only containers with certain code numbers stamped on them. Still others accept only products with specific resin codes that are bottles (having a neck that's narrower than the body). So if you're like me, you might be thinking this is too much too remember, just tell me what CAN I recycle?

It takes 700 years before a plastic bottle begins to decompose in a landfill. Therefore, it is important to know what types of plastic are widely, seldom, and never accepted for recycling so they do not end up in a landfill. The following information is reported on the Waste Management Web site: [12]

What's Widely Accepted? Products labeled Code 1 and Code 2 are widely accepted at recycling facilities. They must be clean before you place them in your bin.

Code 1 = Polyethylene Terephthalate (PET or PETE). PET plastic is the most common for single-use bottled beverages, because it is inexpensive, lightweight and easy to recycle. It poses low risk of leaching breakdown products. It is also used to make fibers such as Polyester and Dacron and thin films such as Mylar. PET plastic composes 18% of the world's polymer production.

Found In: Soft drink, water, mouthwash, and beer bottles, containers for salad dressing, vegetable oil, peanut butter, and oven-ready food trays.

Recyclability: Widely accepted by curbside recycling programs. Please remove caps.

Recycled Into: Polar fleece, fiber, tote bags, furniture, carpet, paneling, and new containers.

Code 2 = High-Density Polyethylene (HDPE). HDPE is a versatile plastic with many uses, especially for packaging. It carries a low risk of leaching and is readily recyclable into many goods. Over 60 million tons of this material is produced worldwide every year.

Found In: Milk jugs, juice bottles, bottles for bleach, laundry detergent, some household cleansers, motor oil bottles, butter, oleomargarine, yogurt tubs, cereal box liners, and some trash and shopping bags.

Recyclability: Picked up through most curbside recycling programs, although most allow only those containers with necks. Please remove caps.

Recycled Into: Laundry detergent bottles, oil bottles, pens, recycling containers, floor tile, drainage pipe, lumber, benches, doghouses, picnic tables and fencing.

What's Less Commonly Accepted? Municipalities often differ on whether to accept products labeled with Code 4 and Code 5. Call your local recycling plant to find out what they accept.

Code 4 = Low-Density Polyethylene (LDPE). LDPE is a flexible plastic with many applications. Historically it has not been accepted through most American curbside recycling programs, but more and more communities are starting to accept it.

Found In: Squeezable bottles, bread wrappers, frozen food and dry cleaning bags, tote bags, clothing, furniture, and carpeting.

Recyclability: Not often recycled through curbside programs. Plastic shopping bags can be returned to many stores for recycling.

Recycled Into: Trash can liners and cans, compost bins, shipping envelopes, paneling, lumber, landscaping ties, and floor tile.

Code 5 = Polypropylene (PP). PP has a high melting point, and so is often chosen for containers that must accept hot liquid. It is gradually becoming more accepted by recyclers.

Found In: Yogurt containers, syrup bottles, condiment bottles, caps, straws, and some prescription medicine bottles.

Recyclability: May be accepted by your curbside recycling programs. Call your local recycler.

Recycled Into: Signal lights, battery cables, brooms, brushes, auto battery cases, ice scrapers, landscape borders, bicycle racks, rakes, bins, pallets, and trays.

What's Almost Never Accepted? Products labeled with Code 3, 6, or 7 are less often accepted for recycling. Check with your local recycler.

Code 3 = Polyvinyl Chloride (V or PVC). PVC is tough and weathers well, so it is commonly used for piping, siding, and similar applications. PVC contains chloride, so its manufacture can release highly dangerous dioxins. If you must cook with PVC, don't let the plastic touch the food. Also never burn PVC, because it

releases toxins into the air.

Found In: Window cleaner and dishwashing detergent bottles, shampoo bottles, cooking oil bottles, clear food packaging, wire jacketing, siding, windows, piping, medical equipment, and also used in most blister packs.

Recyclability: Rarely recycled but may be accepted by some plastic lumber makers.

Recycled Into: Decks, paneling, mud flaps, roadway gutters, flooring, cables, speed bumps, and mats. PVC is commonly used for construction grade applications because of its toughness.

Code 6 = Polystyrene (PS). PS can be made into rigid or foam products, in the latter case it is popularly known as the trademark Styrofoam® . Evidence suggests polystyrene can leach potential toxins into foods. This material was notorious for being difficult to recycle. Each year, Americans throw away 25 billion polystyrene cups, enough to circle the Earth 436 times!

Found In: Some over-the-counter medicine (aspirin) bottles, compact disk cases, disposable plates and cups, restaurant carry-out containers, coffee cups, plates, meat trays, and egg cartons.

Recyclability: Polystyrene is rarely accepted in most curbside recycling programs. Please check with your municipality for specifics.

Recycled Into: Insulation, light-switch plates, egg cartons, vents, rulers, and foam packing, and restaurant carry-out containers. Polystyrene can be made into rigid or foam products usually called "expanded polystyrene." It is popularly known by the trademark Styrofoam® , which should not be placed in your recycling bin. Instead, there are a number of drop-off locations for expanded polystyrene, and they can be found at http://www.epspackaging.org/info.html.

Code 7 (OTHER). Code 7 means that the product in question is made with a resin other than the six "coded" resins; or that it is made of more than one type of plastic. The most common may be polycarbonate, or Lexan, which comprises popular Nalgene® bottles. Polycarbonate is linked with an ingredient called Bisphenol A (a hormone disruptor) and can leach into the food or liquid when the bottle is heated to 175 degrees F (80 degrees C) at about 5 to 7 parts per billion. A few are even made from plants (Polylactide, also known as PLA), and are compostable. PLA is a biodegradable packaging material derived from renewable resources such as cornstarch or sugar cane.

Found In: Three- and five-gallon water bottles, bulletproof materials, sunglasses, DVDs, iPod® and computer cases, signs and displays, certain food containers, and Nylon® .

Recyclability: There is very little recycling potential for most Code 7 plastics at this time. You can place polylactide packaging into a municipal composter or your own backyard compost pile.

Recycled Into: Plastic lumber and custom-made products.

Some plastics cannot easily be made into other products, or doing so is not economically feasible. If your local recycler doesn't accept a particular type of plastic, it's probably because the market for that resin is small or non-existent.

Plastics to Avoid

On a final note, keep in mind there are 3 suspect plastics to avoid. The first to avoid is #3 Polyvinyl Chloride (V or PVC), which, if you remember is found in cooking oil bottles and clear food packaging. Harvard-educated Dr. Leo Trasande of the Mt. Sinai School of Medicine advises consumers to avoid #3 plastics for food and drinks. Polyvinyl chlorides may release toxic breakdown products, including phthalates, into food and drinks (The Daily Green [16]). Phthalates are plasticizers (additives that increase the plasticity or fluidity of the material to which they are added) that are added to polyvinyl chloride (PVC) products to impart flexibility and durability. They are produced in high volume. Phthalates are animal carcinogens and can cause fetal death, malformations, and reproductive toxicity in laboratory animals (American Chemistry [17]). The risk is highest when containers start wearing out, are put through the dishwasher or when they are heated (including the microwave). PVC manufacturing can release highly toxic dioxins into the environment, and the materials can off-gas (the release of chemicals from various substances under normal conditions of temperature and pressure) toxic plasticizers into your home (American Chemistry).

Another plastic to avoid is #6 Polystyrene (PS), which is found in disposable plates and cups, egg cartons and carry-out containers. Why should you avoid using them as much as possible? #6 plastics can release potentially toxic breakdown products, including styrene, particularly when heated (clear colorless liquid used to make thousands of remarkable strong, flexible, and light-weight everyday products)! Think about that little white foam cup you've used for hot cocoa or coffee. You know the one that can keep your drink warm without burning your hands. Doesn't seem so great after all does it?

The last plastic to avoid is #7 (Other), which is found most often in baby bottles, three and five-gallon water bottles and certain food containers. Remember this category contains a wide range of plastic resins that don't fit into the other six categories and, therefore, are lumped into #7. Some are quite safe, but the ones to worry about are the hard polycarbonate varieties, as found in various drinking containers, like Nalgene® bottles, and rigid plastic baby bottles. Studies have shown polycarbonate can leach Bisphenol A (BPA), a potential hormone disruptor, into liquids. According to Dr. Trasande, no level of BPA exposure is known to be truly safe, and recently a government panel expressed some concern that the ingredient causes neural and behavioral problems in children.

If the plastic facts are not enough proof for you to switch, know that reused, unwashed, and unsterilized plastic bottles are a breeding ground for invisible bacteria that nestle in cracks and scratches, we cannot even see. Yuck. On the up-side, artificial biopolymers are starting to be generated from renewable natural sources and are often biodegradable. But in the meantime, why not play it safe and swap out those hard plastic water bottles for #1, #5, corn-based plastics, stainless steel, or even shatter-resistant glass?

Strategies

- We can't solve problems by using the same kind of thinking we used when we created them. ~Albert Einstein

Al Gore, you totally rock! But I'm sorry your global warming film bores my students to tears when I show it in my Earth and Environmental Science class. I'm hoping Melissa Etheridge recorded her song for your film before she watched it, because I'm not sure if she intended to make a pun with her title!

I Need to Wake Up, is Melissa's Academy Award-winning song written for Al's 2006 documentary film, An Inconvenient Truth: A Global Warning. Bring Me Some Water, Just Stand Up, and Cry Baby are just a few more featured singles sung by Melissa; I'm wondering if she titled them after watching his film…ok, I'll stop. The film was incredibly informational, but I asked myself several times, why am I showing this, why haven't I pressed 'stop' yet? The only time my students were wide-eyed with interest was when Al climbed on that scaffold-looking contraption that raised him high in the air in the hopes that he would wobble off, plunge 30 feet down, and face-plant onto the stage. It occurred to me at that instant, these kids want more than just charts and facts up on a screen; they want to be entertained while their supposed to be learning. Knowing that Al Gore, literally, has all the resources and scientists in the world, it didn't matter how well his information was researched and organized and planned, it still wasn't enough to motivate my students. At the end, they were uninterested in Al, and, moreover, still uninterested in the environment.

Upon accepting her prestigious Academy Award, Melissa Etheridge stated, "Mostly I have to thank Al Gore, for inspiring us, for inspiring me, showing that caring about the Earth is not Republican or Democratic; it's not red or blue, it's all green." Just as Al influenced Melissa, I want to influence my students' way of thinking. I want to peak their interest in the environment and I want them to discover their role in it. They should WANT to 'think green' which, to me, means to carry out daily routines with minimal environmental and resource impact, and with the highest degree of sustainability.

How can I accomplish such a feat? My idea involves changing the way my students think. Not an easy task. My students have procured poor habits with regards to reducing, reusing and recycling materials, most likely since they were born. The habits one has today are, to a great degree, influenced by the environment that one immerses oneself in. According to Tristin Loo, "a habit can be uprooted by steadily and persistently working against it. Just as performing a task again and again creates a habit, performing an opposite task again and again eliminates it" (2009 [18]). The formation of a new habit is initially difficult. However, with repeated performance, it takes roots and becomes a part of one's nature.

The first strategy I will use is that of student empowerment. Students become empowered when they feel some ownership of the material in which they are learning. Empowerment is the development of knowledge, skills and abilities in the learner to enable them to control and develop their own learning. Patricia Panitz and Theodore Panitz state that, "Empowerment produces an environment that fosters maturity and responsibility in students for their learning. The teacher becomes a facilitator instead of a director and the student becomes a willing participant instead of a passive follower" (2004 [19]).

Students are also empowered by, "developing their critical thinking, or meta-cognition" (Burrows and Harvey1992 [20]). This requires an approach to teaching and learning that goes beyond requiring students to learn a body of knowledge and be able to apply it analytically. Critical thinking is about encouraging students to challenge preconceptions of their own, their peers and their teachers. Burrows and Harvey also state that, "they should be encouraged to question the established orthodoxy rather than swallow it unthinkingly, and to develop their own opinions and be able to justify them." Empowering students through critical thinking encourages them to think about knowledge as a process they are engaged in. It requires students to self assess, to be able to decide what is good quality work and to be confident when they have achieved it. In short, an approach that encourages critical thinking treats students as intellectual performers rather than as a compliant audience. It transforms teaching and learning into an active process of understanding. It enables students to easily go beyond the narrow confines of the 'safe' knowledge base they've acquired, to applying themselves to whatever they encounter in the future!

In order to accomplish this, I will create activities that translate student knowledge into action because truly empowered students are active. The first activity that will incorporate student empowerment is the viewing of Howard University student, Illai Kenney's video, 1000 Voices. My students will be exposed to the Alliance for Climate Protection, the Environmental Justice and Climate Change Initiative and the Creative Counsel and their 1000 Voices Campaign, which creates video projects highlighting young African American leaders in the climate justice movement. Seeing students who are being active in their community and who are just like them will be a powerful influence. It is my intention to introduce the ideas of environmental justice first so that they will feel more connected to the facts and information that will follow. See Introductory Activities for more specific classroom empowerment ideas.

A second strategy I will employ throughout this unit is a 'hands-on' or constructivist approach to learning. Constructivism is a philosophy of learning founded on the premise that, by reflecting on our experiences, we construct our own understanding of the world we live in. Each of us, "Generates our own 'rules' and 'mental models', which we use to make sense of our experiences. Learning, therefore, is simply the process of adjusting our mental models to accommodate new experiences" (Teaching Effectiveness Program [21]). A Chinese proverb states, "I hear and I forget, I see and I understand, I do and I understand." Although these words may not be the exact translation, they seem to underscore the need for a hands-on approach to science teaching. Without this approach, students must rely on memory and abstract thought, two methods that restrict learning in most students. By actually doing and experiencing science, students develop their critical thinking skills as well as discover scientific concepts. This self-discovery stays with students throughout their lifetimes while memory fades. In my opinion, if students are not doing hands-on science, they are not doing science. Science is a process and if students are not actively engaged in the process, they are not learning. Study after study has shown the value of hands-on learning. Students are motivated and they learn more.

In this unit, students will be exploring water and plastics through small-group laboratories such as a water taste-test lab and a recyclable plastics identification lab. Students will also be researching the history and future of plastic. They will be constructing several chemical formulations of some of the most common plastics with molecule kits and discussing the characteristics of the bonds between the elements. Students will participate in a scavenger hunt for renewable and non-renewable resources, and even determine their own carbon footprint. When students are actively involved in an inquiry activity (discovery on your own or in a group) the teacher will need to talk less and facilitate more. See Hands-On/Minds-On Activities for more specific classroom demonstrations.

The final strategy I will apply to this unit is that of leading effective discussions. In my 7 years of teaching, I have noticed that classes will form a collective personality. This year, for example, I noticed my 4 th block was very quiet and intellectual, while my 2 nd block was quite a humorous and animated bunch. For this reason, it's a good idea to try different techniques and strategies to keep lively discussions going. The Feedback Discussion technique emphasizes the importance of group roles and processes in a discussion and gives students more responsibility for participating in and sharing facilitation responsibilities in a dialogue with their peers (Teaching Effectiveness Program). One way to facilitate this strategy is with points. Students receive positive or negative points each time they participate in a discussion. Award positive points for such things as: taking a stand on an issue, presenting factual or research-based information, or making a relevant comment. Negative points should be given for interrupting, monopolizing, personal attacks or making irrelevant comments. I would use points as a bonus system not as a grade. (This system is totally optional.)

The discussion should be set up as follows: Divide the class into two groups. One group will be part of an inside circle having a discussion and the other half will be taking notes on group dynamics and the quality of

the discussion. The inside group will be given a designated question(s) to discuss on a particular topic. (At the midpoint in the class, the groups will switch roles.) The instructor takes his/her place in the outside circle and should not interfere unless absolutely necessary.

The questions for the discussion may come from the instructor or the students, but the quality of the discussion will depend largely on well-constructed, relevant questions that invite discussion. Fact-based questions requiring primarily recall tend to kill discussions quickly because they are not, what I call, "fat questions". That is they do not elicit any more than a "yes" or "no" answer. One of the first things I teach my students in the beginning of each semester is the difference between a good/fat question and a poor/skinny question. Some questions I may ask might include:

- "Is using stainless steel water bottles better than lets say, a Nalgene® bottle when considering renewable vs. non-renewable resources?"
- "How has overpopulation affected the quality of the atmosphere with regards to global warming?"
- After viewing the movie, The Day After Tomorrow, I would pose the question, "Do you think this type of film could scare people into at least thinking about the environment or the issue of global warming and then actually doing something?" about it?"

Let students write their thoughts down first before you ask them to speak up in class. This gets their mind turned on and gives them the security of having something written down to refer to in case the act of public speaking gets them flustered. It is better to ask a few questions and allow time for the discussion to develop. Sometimes one good question is enough for a 12-15 minute discussion. Plan time for introducing the activity, two rounds of discussion, debriefing with the outside circle and closure (summation or review of what the students learned or became interested in).

The debriefing session should address two things. First, the quality of the discussion: did the question(s) asked get answered well? Secondly, how well did the group work together throughout the discussion? Did they distribute "air time" equitably? Did they encourage shy people to speak? Did they introduce new questions or insights? Did they challenge each other appropriately? Did they help each other clarify their contributions? Did they make relevant contributions? See Discussion Activities for more specific classroom discourse.

Activities

Introductory Activities

1. Shock Value - Prior to unit start, and throughout, students will collect various (empty & clean) plastic materials from home and bring them to class. Students will view real life photographs (with statistics) of everyday materials that are collected on a daily basis in the United States (See Appendix A for example photos).
2. Environmental Justice Videos - Videos I will show in my class highlight young African American leaders in the climate justice movement. Two web sites in particular are:
    - The Environmental Justice and Climate Change Initiative Web site: http://www.ejcc.org/ which offers several videos and articles pertaining to young students taking action in their communities and other national efforts being done to raise awareness about environmental justice. Teachers must preview for their preference of material to be shown in class. The video that I will show my

class is called, 1000 Voices by Illai Kenney.
    - The Goldman Environmental Prize Web site: http://www.goldmanprize.org/ which also offers several videos and information pertaining to activists around the globe who have fought environmental injustice within their own communities and won. The video that I will show my class is about the Goldman Prize winner, Margie Eugene-Richard, of Norco, Louisiana and her battle with toxic and nuclear contamination in her neighborhood.
3. Carbon Footprint - Students must realize what their contribution is to the greenhouse gas emissions that are causing climate change. The Nature Conservancy Web site has a carbon footprint calculator that will measure your impact on the climate. It estimates how many tons of carbon dioxide and other greenhouse gases your daily choices create each year. Footprints can be created for one person or for an entire household! This could be done in a computer lab with the entire class or individually for homework. Students will print and share results with the class. The Web site is: http://www.nature.org/initiatives/climatechange/calculator/.
4. Scavenger Hunt - Students will learn the difference between renewable and non-renewable resources by completing a scavenger hunt in the classroom. Teacher may have to create a chart (T-Chart will work well) contrasting the difference between the two resources prior to the hunt (See Appendix A for example worksheet). The knowledge learned from this activity will be built upon and utilized later in the unit during classroom debates.

Hands-On/Minds-On Activities

1. Green Chemistry Principal #1, No Waste Necessary - Students will simulate the old way Ibuprofen was created and compare it to the new (no waste) way it is being created. This activity will illustrate that as we gain new knowledge, we should not use old techniques if newer ones are more practical and better for the environment. (See Appendix A for syntheses)
2. Green Chemistry Principal #10, Days of Our Lives - Students will participate in an entire class activity using M&M's® to illustrate the issue of chemical bioaccumulation in living organisms. Go to http://www.osee.org/lessonplans/19-1_oct_06_bioaccumulation.pdf for a more specific lesson that can be altered to your liking.
3. #1-7 Plastic Types - Using molecule kits (or students can draw molecules with colored pencils), students will construct the 7 major types of plastic to observe how elements are bonded together to form complex molecules (See Appendix A for molecule diagrams). They will also create a foldable in which students will describe the characteristics of each type of plastic. This foldable will be utilized later in the unit during a classroom debate. A great place to get creative ideas to personalize your foldable for your class is at Dinah Zike's Web site: http://www.dinah.com/index.php. Information to go on the foldable can be found under the Types of Plastics subheading. Students can also make Nylon® to see how chemicals combine to form a plastic polymer. Specific lesson plan available at: http://pslc.ws/macrog/lab/lab01.htm and for those that are weary about using chemicals with your students, go to: http://www.youtube.com/watch?v=y479OXBzCBQ and watch a video instead.
4. Tap vs. Bottled - This lab will, hopefully, prove to your students that tap water is just as good, if not better, than bottled water. With this proof in mind, they may be more apt to purchase a reusable (stainless steel) bottle and refill it with water instead of purchasing packages of plastic water bottles and throwing them away or recycling them into another plastic product. You want them to walk away with the knowledge that no waste is better than new waste! As an extension, students could graph the costs of different bottles of water over a week, month or year and compare it with costs of refilling a reusable water bottle with tap water. This would be a good time to practice a whole class debate (see specific directions for Feedback Discussion under the Strategies heading) by posing the question: "What

in your opinion, is better for the environment, reusable or recyclable bottles and why?"

Discussion Activities

1. RIC Categorizing - Preview facts from hip new Web site: http://takeourplanetback.dipdive.com/blog/525 hosted by the well-known music group, The Black Eyed Peas. Then, in 7 small groups, students will find plastic items that correspond with their group number from the pile of collected items from students' homes. Using their knowledge gained (and their plastics foldable) students will collaboratively explain in writing, illustrations, etc., why their particular plastic items are recyclable or not and what could be done with them. Plastic items with information can be fastened to poster board and used for debate and display.
2. Local Climate Justice - Before researching local environmental issues within your city, I will show will.i.am's (Black Eyed Peas) recently released music video Take Our Planet Back based on Al Gore's 2008 Repower America speech: http://www.wecansolveit.org/page/s/williamvideo. A first action step for students will be to sign up to Repower America with 100% clean electricity within 10 years. Inspire your students with an awesome website for music, arts, action and more called Take Our Planet Back at: http://takeourplanetback.dipdive.com/. Once they become motivated, find local environmental issues off the Internet. This research can be done by the teacher for regular education classes or by the students of an honors class. Feedback Discussion groups can debate how to be active and campaign for an environmental issue that is meaningful to them in their school or neighborhood. Discussing local issues can lead to letter writing to local government officials about student concerns.
3. That's What's Up - This debate could take place at any time during the unit after facts about renewable and non-renewable resources, bottled vs. tap water have been given and understood. A discussion surrounding this question can be debated: What is ultimately better for the environment, plastic, glass or stainless steel water bottles and why? Back up your opinion with facts by telling the pros and cons of each type of material.
4. Research Extension - Using the library and Internet, have students research what happens during the recycling process? Where does the material go and what does it turn into? What are the harmful effects of the recycling process on the environment? What does your community do and how could their current process be improved in your opinion?

Appendix A

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1. 1. Shock Value Photo Examples:

picts 2 million plastic beverage bottles, the number used in the US every five minutes!

2. Scavenger Hunt Examples:
    a. List 5 items in the room that are made from a renewable resource:
    b. What are the water pipes made of? Is this renewable or non-renewable?
    c. Look at the tag of your shirt. What is it made of? R or NR? (hint=100% cotton is R; rayon/Dacron/polyester is NR because its made from fossil fuels)
    d. What are the windows made of? R or NR?
    e. What are the electrical cords made of? Housed in? R or NR?
    f. What is the light source in the room? R or NR?
3. No Waste Necessary Information:
    a.) The Old Synthesis of Ibuprofen has 7 steps and the following waste left over in consecutive order: 4H + 2C + 2O; 2C + 6H + 1O + 1Cl + Na; 3C + 6H + 3O; O + 2H; O + 2H; N + 3H
    b. The New Synthesis of Ibuprofen has 4 steps and the only waste is water and carbon dioxide: 4H + 2C+ 2O
4. #1-7 Plastic Types Molecule Construction:

    Polyethylene Terephthalate (PETE or PET) MOLECULAR FORMULA:

    $(-CO-C_6H_4-CO-O-CH_2-CH_2-O-)_n$

    ub> High Density Polyethylene (HDPE) MOLECULAR FORMULA:

    $(-CH_2-CH_2-)_n$

    Polyvinyl Chloride (PVC, sometimes V) MOLECULAR FORMULA:

    $(-CH_2-CHCl-)_n$

    Low Density Polyethylene (LDPE) MOLECULAR FORMULA:

    $(-CH_2-CH_2-)_n$

    Polypropylene (PP) MOLECULAR FORMULA:

    $(-CHCH_3-CH_2-)_n$

    Polystyrene (PS) MOLECULAR FORMULA:

    $(-CHC_6H_5-CH_2-)_n$

Endnotes

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[1] Carbon Dioxide Information Analysis Center. Global Fossil-Fuel CO_2 Emissions. July 5, 2009. http://cdiac.ornl.gov The CDIAC is the primary climate-change data and information analysis center of the U.S. Department of Energy. CDIAC is located at DOE's Oak Ridge National Laboratory and includes the World Data

Center for Atmospheric Trace Gases.

[2] National Environmental Indicator Series Archives. Global Carbon Dioxide Emissions. July 5, 2009. http://www.ec.gc.ca/soerree/English/Indicators/Issues/Climate/Tech_Sup/ccsup02_e.cfmCanadian website illustrating carbon dioxide emissions from fossil fuel use on global scale from 1950-1994. The trend is easily visible and one can estimate the current emissions and gross world product for 2009 to be above 20,000 megatonnes and 25 trillion US dollars.

[3] North Carolina Department of Public Instruction. Standard Course of Study: 9-12 Earth and Environmental Science. July 10, 2009. http://www.dpi.state.nc.us/curriculum/science/scos/2004/25earth North Carolina State Curriculum Website. State standards, pacing guides, lesson plans and activities are posted for all subjects and all grades.

[4] Charlotte Mecklenburg Schools. Diverse Student Body 2007-2008. July 11, 2009. http://www.cms.k12.nc.us/discover/pdf/08-09/Diversity08.pdf Demographics and statistical data of Charlotte Mecklenburg School System and individual schools.

[5] Flannery, Tim. The Weather Makers. Canada: Harper Collins Publishers Ltd, 2005.

This book takes you through the history of climate change to its developing impact on our planet. Flannery clearly shows the consequences of our daily habits on the planet. This is a hopeful book with solutions and easy suggestions as to how we can change ourselves and help the Earth at the same time.

[6] Noble, David F. The Corporate Climate Coup. May 8, 2007 http://www.zmag.org/znet/viewArticle/15472 A witty summary of the history of corporate climate change campaigns, organizations, and accomplishments.

[7] United States Census Bureau. The 2009 Statistical Abstract: Population. June 9, 2009. http://www.census.gov/compendia/statab/cats/population.html This section of the Website presents statistics on the growth, distribution, and characteristics of the U.S. population. The principal source of these data is the U.S. Census Bureau, which conducts a decennial census of population, a monthly population survey, a program of population estimates and projections, and a number of other periodic surveys relating to population characteristics.

[8] University of California at San Diego. Climate Change: Earth's Climate System. July 10, 2009. http://earthguide.ucsd.edu/virtualmuseum/climatechange1/04_1.shtml Website informing the public about global climate change, carbon dioxide emissions, and several of Earth's systems that are a part of the greenhouse effect.

[9] Environmental Justice and Climate Change Initiative. Climate Justice the Time is Now. July 11, 2009. http://ejcc.org/ The Environmental Justice and Climate Change Initiative (EJCC) is a diverse coalition U.S. environmental justice, religious, climate justice, policy and advocacy networks working for climate justice. Our consensus-based coalition develops projects, programs and papers to educate policymakers and connect with thousands of people in communities across the country about the effects of climate change and environmental injustice.

[10] United States Environmental Protection Agency. Green Chemistry. July 10, 2009. http://www.epa.gov/greenchemistry Describes green chemistry, also known as sustainable chemistry, and how

it is the design of chemical products and processes that reduce or eliminate the use or generation of hazardous substances.

[11] The White House: Office of the Press Secretary. Key Administration Posts. July 7, 2009. http://www.whitehouse.gov/the_press_office/President-Obama-Announces-More-Key-Administration-Posts-5-21-09/

Website giving recent official news from the briefing room, current issues of significance, the administration, information about the White House, our government, and how to contact the White House.

[12] Anastas, Paul T. and Warner, John C. 1998. Green Chemistry Theory And Practice. New York: Oxford University Press. This book introduces the reader to the design, development, and evaluation processes of new green chemistry methodologies.

[13] Sustainweb. Have You Bottled It? July 11, 2009. http://www.sustainweb.org/foodfacts/have_you_bottled_it/ Online article advocating food and agriculture policies and practices that promotes equity and enriches society and culture.

[14] Chartered Institution of Water and Environmental Management. July 11, 2009. http://www.ciwem.org/ CIWEM is the leading professional and examining body for scientists, engineers, other environmental professionals, students and those committed to the sustainable management and development of water and the environment.

[15] Waste Management. What can be recycled: Plastics. July 11, 2009. http://thinkgreen.com/recycle-what-detail?sec=plastics&gclid=CIbTrIvTz5sCFZJM5QodwGQoKw

Website sharing environmental facts and statistics about how to create a more sustainable society. What Waste Management is doing and what we as individuals can do.

[16] The Daily Green. The Consumer's Guide To The Green Revolution. July 12, 2009. http://www.thedailygreen.com/green-homes/eco-friendly/plastic-bottles-toxins-water-bottles-460410 Website giving latest news, tips and advice, information about green homes, new green cuisine and living green.

[17] American Chemistry. Phalates Information Center. July 12, 2009. http://www.americanchemistry.com/s_phthalate/index.asp?gclid=CJ6Kg-r90JsCFYZM5Qodr1P3LA Website containing information on plastics and harmful molecules associated with manufacturing of different types of plastic.

[18] Loo, Tristan J. How To Change Your Habits. June 10, 2009. http://www.synergyinstituteonline.com/detail_article.php?artid=387 The Synergy Institute offers education for life success. There is an article library available for various searches in specific categories. This particular article came from a personal development article library.

[19] Panitz, Patricia and Panitz, Theodore. Encouraging the Use of Collaborative Learning in Higher Education. July 12, 2009. http://home.capecod.net/~tpanitz/tedsarticles/encouragingcl.htm Electronic journal article offering teachers strategies for small group discussion in the classroom.

[20] Burows, A. and Harvey, L. 1992. Empowering Students. New Academic 1 no.3: 1. Online article explaining

the importance and advantages of empowering students in the classroom.

[21] Teaching Effectiveness Program. How Do I Encourage Participation/Facilitate Discussion. July 12, 2009. http://tep.uoregon.edu/resources/newteach/participation.html

Website sharing classroom strategies that are effective and proven positive by teachers. Especially designed for classroom discussions and debates.