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Flexible Enthusiasm: Consumption and Awareness of Plastics in Our Lives

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by Stephanie Brown-Bryant

Purpose

The purpose of this curriculum unit is to bring awareness to the role humans play in our personal and environmental health as consumers of plastics. Marketing and convenience play important roles in our choices of purchases, but how informed are we about the production, regulations, and impact of plastics in our everyday lives? The goals of the unit are to uncover a realm of consumption that outlines possible unscrupulous marketing tactics that promote consumption over conservation and to learn how we can put into practice simple ways to alleviate this problem.

Introduction

When we think about the quality of our lives and the lives of my family, we consider convenience, accessibility and cost. We make sure that bottles of water are at our fingertips to keep us hydrated. We keep many of our food items stored in airtight containers to maintain freshness. We purchase automobiles that are efficient and comfortable. Let's not forget those must have cell phones, iPods, and laptop computers. Have we ever stopped to think, what is all of this comfort REALLY costing us or that our choices as consumers are harming us and the people we love? The idea of unintentionally causing harm through everyday habits and choices seems overwhelming, but the power lies in starting now with a better understanding. Let's acknowledge that yes, there are many perils and we cannot manage them all. Now let's assess one topic that we can become more informed about and actually become catalysts for change. Delve into just one of the thought provoking issues around our need to have and our trust that what we consume is good for us. Think about PLASTICS!

I attempted to trace my earliest and most fond memories of plastics. Tupperware parties were quite popular when I was growing up. At least every few months, some sweet woman from the neighborhood offered a variety of enticing hors d'oeuvres delicately placed around colorful, sleek containers that promised to keep food fresh and easy to transport. It provided income for aspiring homemakers who sold the plastic household necessities, offering "better things for better living through chemistry." As I try to remember how plastics

sneaked into my assumingly boring life with its wooden horses, rubber balls and metal Radio Flyer wagon, I really can't recall how plastic suddenly saturated my life. More importantly, I cannot imagine a life without plastic! Now plastic is everywhere, and I mean EVERYWHERE!!! Just consider everyday items such as the contact lenses on our eyes, retainers in our mouths, the clothes we wear, the cars we drive, and the homes in which we reside, contain plastic.

What Are Plastics

Plastics are types of polymers, synthetic or man-made, that can be molded, shaped, cast or drawn to create products. Polymers are chains of molecules that have repetitive chemical units called monomers. Though natural polymers do exist, (ex - amber, tortoise shells and horns from animals,) semi-synthetic and full synthetic products were not introduced until the late 1800's. The first commercial artificial plastic was created as an answer to a New York manufacturer's request (which offered $ 10,000 but there is no evidence that it was ever collected) for a material that could be used to make billiard balls so that ivory would not have to be used. This new product called celluloid was created around 1863 by John Wesley Hyatt, a printer in Albany, New York, could be molded and dyed to mimic natural products.[1]

Hyatt found his original process to be expensive, (the solvent used was a mixture alcohol and ether,) evaporated slowly and cracked and shrank while drying. Hyatt would soon find that his "problem" had been resolved in Great Britain, as Alexander Parkes displayed at the Great International Exhibition in London. Parkes had recently created a substance that was made from nitrocellulose and camphor in 1862, hoping to satisfy the need for something that mimicked luxury items like the natural polymers mentioned above. They were in high demand but had a limited supply. He eventually had a product that kept its shape as it dried, could be molded just as rubber could, and could be produced more cheaply! Parkes modestly named this product Parkesine.[2]

Equipped with new information, Hyatt used Parkes' technique and advertised a hard, durable substance that withstood atmospheric conditions, (these fascinating characteristics would eventually become a health and environmental nightmare.) Items such as denture plates, combs, handles for utility items, piano keys were manufactured by the Celluloid Manufacturing Company, Hyatt's new company. The new products created using cellulose derived from natural cotton and acid was marveled and described as "perfect imitations" that "defied detection".[3]

Anything You Can Do, I Can Do BETTER!

In 1891, a German chemist named Adolph von Baeyer (pronounced "buyer") was looking for a synthetic dye, (he had long chased a dream of creating a dye the same color as indigo and later received the Nobel Prize in chemistry for his research, created barbiturates and was knighted by King Louis II of Bavaria,) and his student Werner Kleeberg heated phenol and formaldehyde with hydrochloric acid to create a pasty resinous substance. It hardened slowly, but released gas violently (hint, hint…) and became useless due to its porous

and brittle end product.[4]

Along comes a brilliant Leo Hendrik Baekeland who had obtained a Doctor of Science Degree by the age of 21. Baekeland, who left Belgium and settled in New York, realized the potential of industrial chemistry and began working on an improved photographic printing paper to compete with Eastman Kodak (he was an amateur photographer). He created Velox, a photographic paper that could be developed under artificial light and sold it to his competitor, George Eastman, for a million dollars [5] ! Now a millionaire, he began working on a synthetic varnish that hardened wood and happened upon a new polymer that was derived from coal tar. Baekeland combined phenol and formaldehyde, added elements of heat and pressure, and formed a plastic he called Bakelite, pronounced "bay-ka-lite" (yet again, the modesty prevails.) Bakelite is considered the beginning of modern plastics. By 1907, its versatility was seen in many products such as casings for electrical wires, jewelry, radio and telephone casings, kitchenware, and even toys (hello Barbie!).

During the Second World War, restrictions were placed on imported items such as latex, wool, and silk. With an urgency to fulfill a need, many newer plastics were created were introduced. Polyethylene (used for plastic shopping bags), silicones (found in lubricants, sealants, adhesives, gels, coatings and breast implants), epoxies (used as an adhesive and a coating agent) and polystyrene (marketed as Styrofoam). Polyvinyl chloride (PVC) became the new insulation for cable due to limited stocks of natural rubber. PVC was used for Mattel's Barbie dolls because they were described as looking and feeling "real".[6] Advancements in technology pushed the need for lighter, cheaper, and more versatile products. Believe it or not, advertising markets have helped drive the need to create more plastics, thereby placing us even more in harm's way.

From Natural to Not So Much...

By the 1930's chemical technologies were created to use coal, and natural gas or petroleum to develop new plastics. So exactly where does all of this plastic come from? The answer is oil, of course. Around the world, about eight percent of oil extracted is used to make plastic products.[7] It takes two liters of oil (.4 gallons) to make about .5 kilogram (one pound) of plastic.[8] A national survey in 2007 revealed that more than 70% of people did not know that plastic was an oil based product.[9] With skyrocketing gas prices, the depletion of our natural resources is more important than ever. The problem here rests in the fact that we don't know that we are using natural resources to produce plastics!

Better Things for Better People - Marketing of Plastics

After World War II, consumers could have access to plastics via vinyl siding, linoleum, tabletops, rugs, clothing, phonograph records, computers, and thousands of other products.[10] The promise of ''Better things for better living...through chemistry.'' was an advertising motto of the E.I. Dupont Corporation that mesmerized Americans and provided a sense of affluence. The plastic giant produced Nylons, Rayon fiber, and cellophane for food packaging. Americans were living in convenience and loving it!

The Dow Chemical Company joined in and proved to be a strong force in plastics with the creation of Styron in 1937 at $ 0.68 per pound! Beautifully colored picnic forks and spoons made from this new product were illustrated for Monsanto's Lustron and described as "best sellers for exclusive shops for two years".[11] The public bought them at a premium price of $ 2.50 (talk about markup!) These tactics not only proved to be successful, but are commonly used today. We run out to get the "latest and greatest" gadget before others have access, often paying extravagant amounts of money. Technology has provided a continuous cycle of "have to have it now" attached with feelings of entitlement, leisure and superiority seen in commercials, songs, and every type of media you can find. Advertising works! We are definitely hooked on plastics. There's no turning back.

So What Is the Big Deal??

Plastics aren't all bad, you may say. We can agree, to some extent, that our lives are more fulfilling with this great polymer. Rates of production soared without any question of safety on production, use or disposal of plastics. In the 1950's attention was brought early on by the Manufacturing Chemists' Association (MCA) through a set of legal principles that labeled dangerous products. They expressed that the public's level of comfort and trust would increase when buying a product based on materials they know. Furthermore, they stated that companies should take every precaution to produce products that are devoid of toxins. If an assumption existed that a product was harmful, the harmful effects must be placed on the product in an effort to warn and protect the consumer.[12] Quite thoughtful, you might say. Not so fast...

Health Concerns

The "enjoy it now, worry later" mentality brings us to the worrying component. Vinyl chloride, which is used to make a seemingly non-threatening plastic called polyvinyl chloride (PVC) and is used in dry cleaning agents, is now the possible suspect for liver carcinoma.[13] Workers in a plastics factory that were exposed to vinyl chloride were diagnosed with this rare cancer: coincidence? Vinyl chloride is also an organochlorine (a compound made of carbon, chlorine and usually hydrogen). This little tidbit of information is important because organochlorines dissolve more easily in fats than water. Evidence is clearly seen in Inuit mothers who were shown to have evidence of the Mirex, an organochlorine used in pesticides and plastics, in their breast milk.[14]

In the 1990's toxic deposits from municipal-waste and hazardous-waste plants were found in Europe's land commonly used for grazing. These organochlorines were deposited in the milk of the cows.[15] So once they enter the body, they are easily stored in fatty tissue than the bloodstream. Follow along here: the cow eats the grass contaminated from the groundwater that has organochlorines. The humans drink the milk that is high in fat or eat the beef that has fat. The humans...well...you can fill in the blanks from here.

In 1956, a poor, predominately African-American community known as the West End in Louisville, Kentucky found itself in the center of an environmental microscope. Students were given "sniff kits" as a means to

measure of air quality. Technicians from the local B. F. Goodrich Company, one of the world's largest rubber and tire manufacturer, joined the MCA to determine possible harm to the neighbors of their plant. The manufacturing industry discretely distracted the MCA and the need to protect citizens was overshadowed with the need to have more plastic. Almost twenty years passed and the first deaths that could be proven to be caused by cancer were substantiated by that plant.[16] Was it a coincidence?

More evidence of health issues exists when we investigate a geographic area between Baton Rouge and New Orleans, Louisiana. Low labor costs, rich natural resources, few environmental regulations and tax breaks led many corporations to this area.[17] Louisiana had become a leading producer of vinyl chloride and polyvinyl chloride. These industrial companies set up shop and partake in the big business of oil. Impoverished residents, primarily African-American, were soon employed at many of these facilities and lived in the communities nearby.

As years passed, residents throughout the area complained of fumes and vinyl chloride emissions.[18] In the 1980's and 1990's, residents in two communities near a Dow plant discovered that many of their water wells were filled with pollutants from the production of vinyl chloride. As a solution, Dow offered to purchase the town in an effort to relocate the citizens. Should this be considered a kind gesture or damage control before an outbreak of legal actions and negative publicity? Freed slaves had earlier settled in this area. The historical wasteland and toxic inheritance was no prize for these residents. All but twenty Morrisonville residents took the offer and left their beloved homes. This area is now known as Cancer Alley (this name doesn't leave much to the imagination for the consequential disease). Exxon, Shell, Chevron, and Marathon, Boise-Cascade and Georgia Pacific, AlliedSignal, Dow, Dupont, Monsanto, BASF, IMC-Agrico, Uniroyal, and Union Carbide were among the 136 industrial giants that burned and dumped toxins released from plastics into the atmosphere.[19] Unassuming Americans lived under the clouds that rained toxins into the soil and breathed the air that they could not escape.

In the mid 1950's General Motors did not obtain a permit to dump its toxic waste at a plant in New York. For more than fifty years, the Akwesasne Mohawks, who were neighbors to the GM plant, lived off the land they worshipped. They ate the fish and grew their foods from the rich soil provided by the nearby rivers. They swam in watering holes that became a runoff resting place from toxins released as dump heaps grew around the Native American treasure.[20] What they found was a whole lot of polychlorinated biphenyls or PCB's. PCB is another one of those organochlorides that easily enters the body. The landfills, provided by General Motors, leached PCBs into the groundwater and the rivers. Suddenly there was an epidemic of cancers, diabetes, respiratory disease and thyroid problems on the reservation.[21] Because the toxicity of PCBs increases as they move along the food chain (called bioaccumulation), humans who are exposed to these toxins from so many sources became collection vessels of toxicity. The then Attorney General, Eliot Spitzer, demanded the cleanup and threatened criminal action because General Motors had known for at least 15 years that they were harming these people.[22]

The exposure of bisphenol-A,(BPA), one type of plastic that is mainly found in hard and clear polycarbonate plastics is a clear indication that our future is at risk. Specifically, it can be found in plastic food wrap and containers, the inner coatings of metal cans, water bottles, baby bottles, and water pipes. The CDC has found that "95 percent of human urine samples tested has measurable BPA levels,".[23] BPA travels easily across placenta and has been shown to be harmful to male and female reproductive organs in animal studies.[24] A recent study showed that low blood levels of BPA are related to ovarian disease.[25] It can be assumed that many other dangers may not be addressed until future incidents of health concerns arise due to lack of

research before newer plastics are distributed.

Fast forward to your exposure to plastics. Some of the old culprits are still with us. We transport ourselves and our families in the safest, plastic enhanced automobiles with the thought that we are making thoughtful decisions with good intentions. New cars were comprised of approximately 136 kilograms (300 pounds) of plastic bumper to bumper by 2008.[26] Constant communication is provided at our fingertips with our cell phones and information is only a click away with our computers and peripheral devices. Our houses are wrapped in Tyvek (plastic that protects the house from moisture) and our water is delivered through PVC pipes for drinking, laundering, and bathing. Wait before you quench that thirst!!! Designer water is perfectly packaged for our on-the- go lifestyle, mobile and compact for proper hydration. All the while toxins from these plastics easily enter our bodies from literally thousands of opportunities of exposure to plastics.

Our precious babies are swaddled in plastic diapers, nourished from plastic bottles, accessorized with the latest trendy toys and trinkets to keep their attention. They roll around in great laughter on our plastic rugs and carpets, are clothed in our plastic textiles, and sleep in cribs coated in plastic ladled paints. Our best intentions are to provide comfort and safety for them. Do they have a choice in the toxic environment that we have chosen for them?

Out of Sight, Out of Mind

Recently, awareness has been placed on research and hazards of production, use and discarding procedures of plastics. The United States produces approximately 136 billion kilograms (300 billion pounds) of plastic each year. Each American discards an average of 680 kilograms (three quarters of a ton) of garbage a year.[27] In 2007, the Environmental Protection Agency reported that Americans created almost 14 billion kilograms (14 million tons) of plastics in the municipal solid waste stream.[28] Within that amount, plastics constitute almost 11.7% of our waste. Realistically, we don't think about how much plastic we use because we are more concerned about the convenience.

The disposal of many plastics has caused much controversy. PVC is one of the most troubling because of the proliferation and disposal. The United States produces approximately 4.5 billion kilograms (10 billion pounds) of PVC resin annually. Sixty percent of that that amount is used in construction. Because of the difficulty to recycle PVC, it is often incinerated and dioxins are released in the air. Dioxins are well known carcinogens and have shown to be dangerous at very low amounts.[29] They also affect the immune system, reproduction, and child development much more significantly than previously thought.[30] Another concern is DEHP, which is added to PVC to increase its durability and strength. It does not evaporate easily, binds strongly and remains in the area in which it rests. Landfills are filled with PVC and DEHP, being the loyal hazard, moves just far enough to slowly leach into our water.[31] Okay, so there's a problem with PVC, but what about all those other plastics? And besides, we can always recycle the other plastics, RIGHT?!?

Are We Really Recycling?

Forty percent of Americans believe that plastic biodegrades (meaning naturally breaks down) in landfills, oceans, and composts. Once again, we have assumed that the responsibility of an immediate risk is carefully managed with our best interest in mind. The United States employs China to export some plastics; many of our polyethylene bottles are transported to China for plastic waste.[32] This may be because it is cheaper to dispose and there are less stringent regulations on recycling and pollution prevention. Increases in the use of plastic have been directly linked to the amount of marine litter.[33]

An area of concentrated floating debris known as Garbage Island located in the North Pacific Gyre is estimated to be twice the size of Texas has been discovered in the Pacific Ocean and is continuing to grow. Our natural cycle of life is now victims of plastics as the smaller marine animals feed from the plastics dumped in the ocean, the fish eat the smaller animals, and we eat the fish, and so on. Soon, if you "teach a man to fish" you he'll eat with the increased chance of ingesting carcinogens prepared for nourishment.

In the United States, plastics must be separated due to resins that may be toxic when manufactured into new products. In addition, the cost to complete this process is a deterrent for most companies. Unfortunately, the task of carefully managing the potentially deadly substance is placed in the hands of others. To add insult to injury, the American Plastics estimated that only about five percent of manufactured plastics were recycled.[34] I repeat (testing one, two…clearing my throat this time…did you hear that…) ONLY ABOUT FIVE PERCENT OF MANUFACTURED PLASTICS WERE RECYCLED!!! Unbelievable!

Plastic is not biodegradable which makes it even more important to monitor its consumption. Most plastics break down through photodegradation (to break down with light), oxidation (to take away hydrogen, as by the action of oxygen; add oxygen or any nonmetal) and mechanical abrasion (the removal of surface impurities, usually by sandblasting).[35] This natural resource is not only needed to fuel our modes of transportation, but it is also used in fertilizers, perfumes, beauty products, medicines, and other household items.

This guides a discussion that centralizes our need to be more informed about issues that directly affect us. Issues in trade (we receive most of our plastic from China which has had a problem with regulations of products) should prompt us to become more engaged in our consumption. This topic is one that should be examined more closely, but I digress with caution to focus on something you, the citizen and consumer, may find great joy in knowing. Our world can be better! We are flexible enough to exhibit the durability of our moral consciousness (oh, the puns!)

Trust Yourself to Do Something Good For Yourself and Others - Easily!

Close your eyes and think of the wonderful things that you will do to minimize exposure. Thoughtful decisions not confined in the trickery and emotional groundings provided by persuasive advertisements will be made to limit plastic use and decrease production. Spread the word! Treat your knowledge like juicy gossip that you must tell or you will simply explode! Continue to recycle with an effort to conserve as well. More importantly, encourage your family, friends and community to become more informed about health and social issues such as the ones discussed with the hope that our lives will be long-lived without the guilt of allowing others to determine our fate.

Strategies for Implementation

Time allotment: 8-10 class periods (Access to technology and class size may impact this timeframe.)

My students are sixth, seventh and eighth graders in a suburb of the Atlanta area. Most students are aware of dangers of pollution and the importance of recycling, but many don't exhibit awareness during the school day. Many students do not recycle at home and are not concerned about their role as consumers in the issue of protecting the earth. Implementation of this lesson will include class discussion, cooperative grouping with no more than four people per group (ideally two to three people to allow everyone an opportunity to have a leadership role), and individual research when students are required to bring personalized ideas to the discussion.

An excellent way to immerse yourself in the growing concern and immediacy for action is to watch the three part movie entitled "Toxic Garbage Island". It can be viewed online at http://www.vbs.tv/watch/toxic/garbage-island-1-of-3. This thought-provoking documentary produced by VBS.tv commands attention to the problem of plastic consumption and pollution in our waters. One must be warned that there are quite a few expletives, so I would recommend that only consenting adults watch this. It can be used in part to show students without audio, but be mindful of the language.

As time and resources permit, the utilization of electronic research databases and websites are ideal and will allow students the use of technology. Students should be able to summarize information and properly document their sources to encourage scholarly research. One resource that I use often for research is provided by the University System of Georgia (I am very proud of this invaluable resource). Georgia's virtual library can be accessed at www.galileo.usg.edu. Log in as a guest and enjoy! Technology has a strong presence in my classroom. Therefore, I would encourage you to use slideshows, spreadsheets, flyers, brochures, and even digital video editing to allow students to create visual representations of what they have learned. Clip art, templates for flyers, slideshows and brochures are available for educational usage at no charge at www.microsoft.com. Don't hesitate to use tutorials available on the website if you are not familiar with the resources available at this site.

To differentiate instruction, I would encourage gifted and accelerated learners to think more globally and use historical implications such as effects of trade, wars, and the economy to determine the roles they play in our consumer habits. (ex - How do wars affect what we buy? How do trade agreements affect what we are able to buy? Are there concerns with regulations in trade with other countries?) Students that may require more support should be encouraged to use real world problems on a smaller scale (ex - How much plastic is used during my breakfast? Does the amount of plastic used to package an object affect the price? How can I compare items before I buy them so that I am being a smart consumer?)

Stage One - You as the Consumer

Objective: The student will identify and discuss the use of marketing in consumable items and identify ways to reduce waste. The student will also identify ways to preserve natural resources by identifying innovative alternatives. We will begin the lesson by identifying and listing plastics commonly used that may be found in

the classroom or in their homes. Students will then select one place in the school or home and select one or two items that are completely made of plastic. A chart for identifying plastic classifications and examples of items in each category can be found at http://www.coffeecountyrecycling.com/Plast http://en.wikipedia.org/wiki/Resin_identification_code ic%20Classification.pdf

They will then count approximately how many items are consumed in one day in that area, (for example, "How many plastic bottles are used by students in the cafeteria during lunch for sixth graders?) If possible, it would be helpful to have a count for the entire population for that day. They will then weigh one of the items selected and estimate approximately how much plastic consumption occurs for each student per day, month, and a school year. This can be created on a spreadsheet for easy comparison and graphing. This issue can be used to research approximately how much oil is used to create the item. A discussion of depletion of natural resources should occur and alternative methods of energy should be researched to identify the need to be conscientious of our usage of such resources. You can prompt the discussion with the following questions:

"If we are using oil for plastics, heating homes, cooking, and fuel for automobiles, how will that affect our oil supply?

"What are some alternatives available to us today that will assist in minimizing the use of oil?"

Students will then be prompted to examine why we purchase and consume the items that we use. They will be asked to list items that they simply cannot live without and why. They will then be asked if plastic is a component of that product. Since food packaging uses a large amount of plastic, provide a few items and ask students how they could be repackaged to use less plastic. In addition, students can research which companies have created innovative solutions to our plastic problems (a biodegradable bottle can be seen at http://www.biotaspringwater.com) and discuss how marketing and advertising can be used to encourage the purchase of products that contain fewer plastics.

Stage Two - You as the Recycler

Objective: The student will describe the importance of recycling. The student will also identify types of energy used in the recycling process. Students will research ways plastic is recycled. They will identify which types of plastics are recycled and what percentages they are recycled. (It is important for students to realize that each stage of the life of plastic requires energy. Production (companies use different types energy to create plastic), exporting (the products are shipped or driven to their destinations which consumes energy), and recycling (they are incinerated, dumped in landfills, or reused to create new products) which all require energy. What types of energy are used during the life of a plastic item? How much energy is needed to recycle an item? Is this type of energy renewable? In addition, students must realize that due to the chemical composition, there are limitations as to what products can be made from recycled plastics. One can refer back to chemical compositions and recycle codes discussed in Stage One during the discussion.

Stage Three - You as the Global Citizen

Objective: The student will identify issues of consumption and recycling of plastic in other countries. The student will present ideas about the importance of carefully selecting products and create informative and entertaining presentations that exhibit their ideas. It would be a great discussion for students to review how other countries are tackling issues of plastic consumption (bans and taxes in some countries) and current events surrounding major incidents of health implications and issues of trade with other countries. Students can research the effectiveness of these programs and create a smaller scale program in their homes or school. Discuss how some countries are banning plastic bags or charging for their use. Students should be encouraged to start small with less consumption at the forefront and better use of plastic goods after initial usage next. Creativity and ingenuity can be used to promote more conscious consumption. (For example, students can share their findings with a cafeteria manager or school principal and ask if they can be a part of minimizing consumption of plastics in the building.)

They can also create informative and entertaining ways to persuade others to share in their challenge to minimize plastic consumption. This can be in the form of a video, skit, brochure, or other form of art.

Criteria may include:

- How well students deliver an understanding issue of consumption and the role we play
- How many facts they are able to include that are pertinent to their environment
- How many resources were used to manufacture the product
- How creative and entertaining was the product

Products can be presented in the classroom, school-wide via closed circuit, podcasts or graphic presentations posted around the school or at parent-teacher-student meetings. Solicit the help of your media or technology specialist to assist you with technology implementation if needed. The school can get involved by having contests that check students' awareness after the campaign to minimize consumption is given at school. Recycling clubs can be formed if none exist and future technologies can be researched and discussed.

Students may even contact community leaders, lawmakers, local businesses, corporations or producers of their favorite item listed in Stage One and ask what steps they are taking to minimize the production of plastic products or what challenges have they had in their quest to minimize consumption and the use of plastics. Students can also ask if they have suggestions as to how they can promote consciousness in the school and the community. Be sure to include media awareness by asking students how many references can be found in the media about the problem with plastics and possible solutions.

Reflection

Armed with the rich history of plastics, the social, health, environmental and economic issues that accompany plastics, students have a beautiful opportunity to share with their loved ones the great difference we can make. The ultimate goal of this unit should be to alter the actions and consciousness of students and adults alike - hoping that they will allow their new-found habits to creep into others' lives just as plastic has crept into

ours. The teacher/facilitator should allow students to revisit the discussion by asking if there are noticeable changes in consumption around them and ask for evidence. Students should continue to keep up with current events and share observations of change. Encourage them to let their voices be heard through their actions and to continue to be thoughtful citizens to protect themselves and others.

References

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Curlee, T. Randall. The Economic Feasibility of Recycling: A Case Study of Plastic Wastes. New York: Praeger Publishers, 1986.

Jensen, Derrick, and Aric McBay. What We Leave Behind. New York: Seven Stories Press, 2009.

Magazine, Discover. 20 Things You Didn't Know. http://discovermagazine.com/columns/20-things-you-didnt-know (accessed July 2009).

U.S. Environmental Protection Agency. Wastes - Resource Conservation - Common Wastes & Materials. http://www.epa.gov/waste/conserve/materials/plastics.htm (accessed July 12, 2009).

Reading List for Students

Brice, Raphaelle. From Oil to Plastic . Ossining, New York: Young Discovery Library, 1988.

http://www.howstuffworks.com/search.php?terms=plastics - Offers a comprehensive history and provides information about production and new technologies in the industry.

http://www.howstuffworks.com/search.php?terms=recycling - Provides videos, process and ways individuals can become a part of the solution.

http://www.stopwaste.org/docs/recyclingguide.pdf - Recycling tips and resources: Alameda County, California provides a variety of resources. A recycling guide can be found here.

Materials for Classroom Use

Clip art or other media - free at www.microsoft.com

Consumable items that contain plastic (water bottles, packaged food items, plastic grocery bags, etc.)

Internet access for research (whole class or group setting)

Magazine, Discover. 20 Things You Didn't Know. http://discovermagazine.com/columns/20-things-you-didnt-know (accessed July 2009). Type "plastics" in the search engine.

Multimedia software that allows creation of spreadsheets, slideshows, digital video presentations or presentations for print

Plastic recycling classification - http://www.coffeecountyrecycling.com/Plast http://en.wikipedia.org/wiki/Resin_identification_code ic%20Classification.pdf

Video of biodegradable bottle - http://www.biotaspringwater.com

Video of Toxic Garbage Island - http://www.vbs.tv/watch/toxic/garbage-island-1-of-3 . Remember there is mature language. Do not include audio!

Virtual library - www.galileo.usg.edu.

Appendix - Implementing District Standards

Grade: 3

Description: S3L2 Students will recognize the effects of pollution and humans on the environment.

Elements:

a. Explain the effects of pollution (such as littering) to the habitats of plants and animals. b. Identify ways to protect the environment.

1. Conservation of resources

2. Recycling of materials

Grade: 6

Description: S6E6 Students will describe various sources of energy, and with their uses, and conservation.

Elements:

a. Explain the role of the sun as the major source of energy and the sun's relationship to wind and water energy. b. Identify renewable and nonrenewable resources.

Grade: 7

Description: S7L4 Students will examine the dependence of organisms on one another and their environments.

Elements:

a. Demonstrate in a food web that matter is transferred from one organism to another and can recycle between organisms and their environments. c. Recognize that changes in environmental conditions can affect the survival of both individuals and entire species. e. Describe the characteristics of Earth's major terrestrial biomes (i.e. tropical rain forest, savannah, temperate, desert, taiga, tundra,

and mountain) and aquatic communities (i.e. freshwater, estuaries, and marine).

Endnotes

[1] Meikle, Jeffrey L. Americal Plastic: A Cultural History. New Brunswick, New Jersey: Rutgers University Press, 1995.

[2] Ibid

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[4] May, Eric, and Mark Jones. Conservation science: heritage materials. Kongens Lyngby, Denmark: RSC (Royal Society of Chemistry) Publishing (online), 2006.

[5] Gutsche, C. David. Calixarenes: An Introduction. RSC (Royal Society of Chemistry) Publishing (online), 2008.

[6] Meikle, Jeffrey L. Americal Plastic: A Cultural History. New Brunswick, New Jersey: Rutgers University Press, 1995.

[7] Vieru, Tudor. Plastic in Our Cars Takes Up 100 Gallons of Oil per Vehicle. May 27, 2009. http://news.softpedia.com/news/Plastic-in-our-Cars-Takes-up-100-Gallons-of-Oil-per-Vehicle-112675.shtml (accessed July 13, 2009).

[8] Ibid

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