Two years ago, I was sitting in class, listening to a lecture on biodegradation. My teacher was explaining the amount of time it takes for different substances to break down. She had mentioned things like apple cores, tree branches, and, finally, the plastic bag. My teacher explained that it could take a plastic bag twenty to a thousand years, depending on the conditions, to fully biodegrade. I found myself confused. In twenty years, I did not think it was possible for toxic plastic to be transformed by bacteria and break down. I also did not see it possible for little pieces of plastic to become similar forms of matter in soil. For weeks after the lecture, I was busy researching. I read more about the life spans of different types of plastic and the role UV light played in breaking plastics down. I did not find anything on what happened after plastic "breaks down," and thus, was not satisfied with my answer. I then contacted a local marine research program and a student at College of the Atlantic in Bar Harbor, Maine to learn about both of their work with plastics.

I was introduced to the term *microplastic:* small pieces of plastic under 5mm in length, ether broken down from bigger pieces of plastic or manufactured to be that small. Microplastics can be different colors and shapes, depending on what type of plastic they originally broke off. The scientists explained that plastic polymers do not biodegrade. Rather, they photo-degrade by 'breaking down' from mechanical and chemical weathering and get smaller. What is extremely dangerous about these small pieces of plastic is that they absorb and release potentially high concentrations of harmful chemicals like PCB and DDT. These chemicals are going into the ocean, and are also going into marine life when they are mistaken for food.

This was eye-opening information for me, and I wanted to know more. I wanted to know what these microplastics looked like, and where they were found. I spent hours hunched over a dissecting scope collecting water samples, filtering, counting microplastics, and recording my data to find answers. After analyzing some of my own data from both the inner and outer parts of Blue Hill Bay, I found shocking information: every 500mL water sample I filtered had microplastic. Samples ranged from eight to 132 pieces. I also looked at studies of microplastics found in sand at beaches. I read that, "researchers have found that of the sand samples taken along shorelines, one-quarter of the weight may be plastic particles" (Ransford).

When humans think about plastic as a growing problem in our marine ecosystem, some may think of the cliché sea turtle with a plastic six-pack around its shell. However, this is only the most visible layer of the plastic catastrophe. When the plastic starts to fall apart and breaks away from the sea turtle, it breaks down to the size of microplastic and gets consumed by all levels of the food chain, from zooplankton to fish to whales to humans. This former six-pack has now absorbed the PCB and DDT chemicals that have been outlawed over 30 years ago, but still exist today in our waters and sediment. Captain Charles Moore of the Algalita Foundation describes these plastic bits as "poison pills moving all the toxics around the marine environment" (Moore). The amount of plastic and contaminants that humans consume on average is not an immediate problem, but has a huge potential to be over time.

Plastic already has chemicals in it when it is manufactured. The plastic found in oceans showed high levels of styrene trimer, a polystyrene by-product, and bisphenol A (BPA), a chemical used in hard plastics. Styrene monomer is a suspected carcinogen,

while BPA creates problems with animals' reproductive systems. In addition to being manufactured with toxins, these plastic also act like sponges and pick up other chemicals that are released into the water. Captain Charles Moore explains, "plastic pellets have been found to accumulate up to one million times the level of these poisons that are floating in the water itself" (Moore). The plastic is absorbing persistent organic pollutants (POP's). The most common POP's are PCB and DDT. PCB is a cooling agent used in electrical equipment and machinery, and DDT is a pesticide that was once used to kill off insects for agriculture and, during World War II, to combat insect born diseases (WAToxics).

The other problem that these plastics create for marine creatures is that once they are consumed, they are impossible to pass, causing animals to think that they are full. This results in starvation, dehydration, and potential death. It was recorded that "44% of all seabird species, 22% of Cetaceans, all sea turtle species, and a growing list of fish species have been documented with plastic in or around their bodies" (5 Gyres). Sylvia Earle talks about a whale on the coast of California that was found with 400 pounds of plastic in its stomach (Earle). This issue has the potential to negatively affect all trophic levels, putting our whole marine ecosystem in danger. It also has the potential to expand even further to our whole ecosystem because of animals like sea birds, which spend time on both land and water.

The sources of this plastic are widespread, but can be narrowed down to one culprit: humans. Plastic is a one hundred percent man-made invention that has become more popular within the last twenty years. Plastic has become the go-to material because it is lightweight, durable and cheap, making it extremely popular across the world and

especially in the United States. Look around where you are sitting. How much plastic is in the room? Think about all of that plastic in this room broken down in the ocean, absorbed with toxins. Some uses of plastic may be necessary, and, sources like piping, medical usage, and Tupperware are okay. These kinds of plastics are acceptable because they are used for a long time, and are generally beneficial to the environment and human health and safety. What is not okay is the single-use plastic that is made to last forever and is disposed minutes after use like plastic grocery bags, Styrofoam, straws, plastic cups, and plastic utensils. One-use, disposable plastic is not the answer, but unfortunately this is what a lot of our county is turning to on a daily basis because it is more convenient than some of the alternatives. It has been recorded that "Americans use 4-million plastic bottles every hour" (NIU).

It was recorded in 2007, that the most common form of plastics that were found in the marine environment was polypropylene at 24%. This form of plastic comes from rope, netting, and bottle caps. The second, low-density polyethylene, comes in forms like plastic bags, bottles, netting, and drinking straws. Other high classes of plastic found are polyvinyl chloride, high-density polyethylene, and thermoplastic polyester (Adventure and Science). All of this is coming from our waste, whether it is put into the oceans from ghost fishing or carless disposal.

Other sources of plastic come from major industries and shipments that get lost or disrupted. With all of the plastic production, plastics have to go through the manufacturing process. Before they are melted, molded, and colored into the desired product, raw plastic is stored resin pellet form called nurdles. This means that they are in small multi-millimeter disk shape pellets, ready to be made into something else (Tuat).

These pellets have to be transported by land and sea to different factories, giving lots of opportunity for accidental spills. There have also been stories of already processed plastic being accidentally let into sea. Specifically the story *Moby-Duck*, a book about 28,800 bath toys getting lost at sea. This story supports the fact that the ocean is downhill from everywhere, and that the bath toys did not break down, but rather ended up stuck in gyres, polluting the marine ecosystem.

Some sources of plastics you would not think of are the tiny sources of plastics that are in plain view. Because our culture relies so heavily on plastics for so many things, you should not be surprised to learn what they have packed plastic into. The first is soap, body washes, and facial scrubs. As a rule of thumb, most mass-produced exfoliating soaps, facial scrubs, and body washes will have “micro beads” or “microcrystals” in them. This means that what is actually exfoliating your skin are little dyed plastic beads. You can double-check by looking at the ingredients for polyethylene. These beads will then conveniently travel down the drain, not stopped by most treatment systems, and flow directly into the ocean. Microplastics can also be found as a result of air blasting boats, houses, or cars. This is when a pressured air stream releases plastics that are used to chip off or clean a surface. Another down side to these hidden plastics is the size. They are already small enough to be classified as microplastic and start absorbing chemicals and killing animals right away.

Plastics can also leak into the environment outside of the trash stream. A newly researched source of microplastic is fleece being washed. Fleece is made out of synthetic plastic,; every time it is washed in the washing machine, small parts break off, and get washed away with the dirty water. Mark Browne, a post-doc fellow at the University

College Dublin did a study on microplastics produced while washing fleece and discovered, "that washing a fleece could produce nearly 2,000 micro-fibers of plastic pollution" (Sharply). When I was first researching plastics, I was learning a lot about UV light and the role that it plays in breaking plastic down in the water. This is true in water, but it is also true for plastics on land. If a shard of plastic, such as a tarp, were left outside and exposed to harsh UV light for an extended period of time, it would start to fray and fall apart. When precipitation came and washed through the watershed, those small pieces of plastic would be off to sea. Thousands of pieces of plastic can make their way into the water by simply just existing.

Some companies have tried to come to with remedies for America's sudden increase in plastic use. A few have gotten into the idea of "biodegradable" plastic, which is the mixing of plastic with corn products. They claim that because there is corn mixed in, the product is now both biodegradable and compostable. But they are forgetting about the "plastic" part in their "biodegradable plastic." The corn will cause the product break down faster, but the plastic that it is mixed with the corn will still be there, just in microplastic form.

People want a solution, but it is not that easy. The only way we can reduce microplastic is by making a conscious effort to use less plastic from the beginning and recycle what we do use. In my family, I have made requests for both big and small changes to cut down on plastic. We bring our own bags to the grocery store, no longer buy bottled water, wrap sandwiches in wax paper instead of plastic bags, and use natural exfoliates. The amount of plastic we use today compared to the amount we were using two years ago has changed a considerable amount. I recently started boarding at a new

school with new people, and I continue to be an advocate towards minimizing plastic. Some of the girls had no idea their body wash was filled with plastic beads, or how much plastic they were going though a day. We are forced to look at the question: What will our ecosystem look like in ten years if the mass-productions of plastic do not stop? We cannot change the damage we have created for our marine ecosystem, but we can prevent it form getting worse.

I believe that public awareness is key, and that people need to know how their actions are affecting our marine ecosystem. The general public needs to know how much plastic we are all putting in the water, how many chemicals are being put into animals' bodies, and which the organisms, both big and small, we are killing because we love our convenient plastic material too much. We can all turn this around by being conscious about our role impacting the ocean; we just have to make the effort.

Bibliography

Capt. Charles Moore: ...the ocean is downhill from everywhere… Perf. Captain Charles Moore. *Algalita Marine Research Institute*. N.p., n.d. Web. 26 Apr. 2013. <http://www.algalita.org/ >.

"Plastic Facts." *NIU*. N.p., n.d. Web. 29 Apr. 2013. <http://www3.niu.edu/recycling/alum_facts/page4.html>.

"What's Plastic Resin Pellet?" *What's Resin Pellet?* N.p., n.d. Web. 28 Apr. 2013. <http://www.tuat.ac.jp/~gaia/ipw/en/what.html>.

Harris, William. "How Long Does It Take for Plastics to Biodegrade?" *HowStuffWorks*. N.p., n.d. Web. 29 Feb. 2012. <http://www.howstuffworks.com/science-vs-myth/everyday-myths/how-long-does-it-take-for-plastics-to-biodegrade.htm>.

"Trash." *Rozalia Project*. N.p., n.d. Web. 29 Apr. 2013. <http://www.rozaliaproject.org/trash/>.

"5 Gyres - Understanding Plastic Pollution Through Exploration, Education, and Action." *5 Gyres – Understanding Plastic Pollution Through Exploration, Education, and Action*. N.p., n.d. Web. 29 Apr. 2013. <http://5gyres.org/>.

"Why Trashing the Oceans Is More Dangerous Than We Imagined." *Popular Science*. N.p., n.d. Web. 26 Apr. 2013. <http://www.popsci.com/environment/article/2008-04/why-trashing-oceans-more-dangerous-we-imagined>.

Think Twice Before Composting your Lint – The Daily Green – Dan Shapely – Copyright 2012 – Accessed 10.12.12 – Web. – <http://www.thedailygreen.com/green-homes/latest/micro-plastic-pollution-1011>

Andrady, Anthony L. "Microplastics in the Marine Environment." *Adventure and Science*. N.p., n.d. Web. 18 May 2013. <http://www.adventureandscience.org/uploads/7/3/9/8/7398741/andrady_2011_mar_poll.pdf>.

"PCBs and DDT." *Washington Toxics Coalition*. N.p., n.d. Web. 18 May 2013. <http://watoxics.org/chemicals-of-concern/pcbs-and-ddt>.

Sylvia Earle. Perf. Sylvia Earle. *YouTube*. Plastic Oceans, n.d. Web. 18 May 2013. <http://www.youtube.com/watch?feature=player_embedded>.