TRASH MAPPING

Sophia Militello
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University of Washington –
Community, Environment, and Planning

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Abstract

Seattle is a hub for sustainability. One important aspect of obtaining a sustainable society is to divert material from local landfills to alternatives such as recycle and compost centers. However, despite efforts to educate people about these choices, many people remain confused when confronted with a series of bins for depositing their trash. That being said, which bin offers the most sustainable path for a specific piece of waste? In order to answer this question, I have created my own posters that illustrate the path that items follow after being deposited in a compost, recycling, or landfill bin at the University of Washington. To create the posters, I contacted composting and recycling processing experts, visited local waste management facilities, analyzed current bin signage, and researched the role that ordinary people play in the success and failure of waste diversion. My hope is that these posters will produce a more well-informed community that cares to take the time to properly dispose of their waste, promoting a more sustainable future.

Introduction

My senior project, *Trash Mapping*, focuses on the various pathways waste can travel within and beyond Seattle. Looking specifically at how the various waste bins, recycling, compost, and landfill, influence and direct the pathway of a single piece of waste, my project takes a closer look at the waste management system of Seattle. With a goal to clarify and promote intentionality, my senior project defines how and why an individual should properly sort their waste through the analysis of the current standards and processes in place.

My interest in waste management began when I moved to Seattle. With a unique disposal opportunity of compost, Seattle is one of a few cities that offers its residents industrial compost pick up alongside recycling and landfill dumping. The City of Seattle has worked to facilitate the process through curbside pickup for all three bins and it is up to the residents to separate their waste and increase the city's overall waste diversion.

My interest in waste management expanded when I learned that China had begun rejecting recyclables from countries, including the United States. In January 2018, China established a new standard for less than 0.5% contamination in recyclables, pushing Seattle to improve its inefficiencies in its waste management programs. The three bins as an option is beneficial to waste diversion and for reducing greenhouse gas emissions, but it leads to placement confusion for the general public. By increasing the clarity of pathways traveled by waste and creating better educated individuals, waste will properly be sorted, and contamination will be reduced across the bins.

The confusion that comes with waste separation is apparent from daily disposal habits. I see it in my day to day life in the various bins in my sorority house. In a sorority house with over a hundred girls, I grow increasingly aggravated with the lack of care when it comes to separating one's waste. My frustration leads me to the question I asked myself throughout my project: *what is the most sustainable pathway our waste can follow?* More specifically, when disposing an item at the University of Washington, where does it go after it leaves the university? These questions offered me the opportunity to explore the pathway of my waste beyond my disposal and create an info-graphic to educate individuals on *why*?

Literature Review

Seattle is a leader in waste management within the United States, but there remains an ability to grow and improve with their implemented programs. The focus of my project is on the pathways that waste travels, and which pathways are the best for our natural environment. I am focusing on the pathways in order to show people what happens to their waste after it leave their curb and to prove why they should care to sort their waste. This literature review will discuss Seattle's successes, Seattle's setbacks, and Seattle's failures in waste management, pointing to the superior path that every piece of waste should travel.

I am looking at waste beginning at the University of Washington, Seattle Campus to the end of its lifecycle. The university does not do its own processing and therefore works closely with King county's waste management facilities. Once waste leaves UW it becomes a part of the greater Seattle area's processes. That being said, it is important to recognize how well the smaller community of the University of Washington is doing at sorting their waste, prior to leaving campus to be processed by an external group. I believe it is easier to educate a define group of people and there are various studies relating to the university's efforts in increasing its waste diversion. With a university goal of having 70% waste diversion by 2020[1], UW has a long way to go. The drive for UW to increase their waste diversion is due to the production of greenhouse gases. UW recycling focuses on how their recycling impacts emissions produced collectively. The university's improvements can be seen in figure 1.

[1] University of Washington. (2018). *UW Recycling Annual Report 2018*(Rep.). Retrieved https://facilities.uw.edu/files/media/uw-recycling-annual-report-2018.pdf

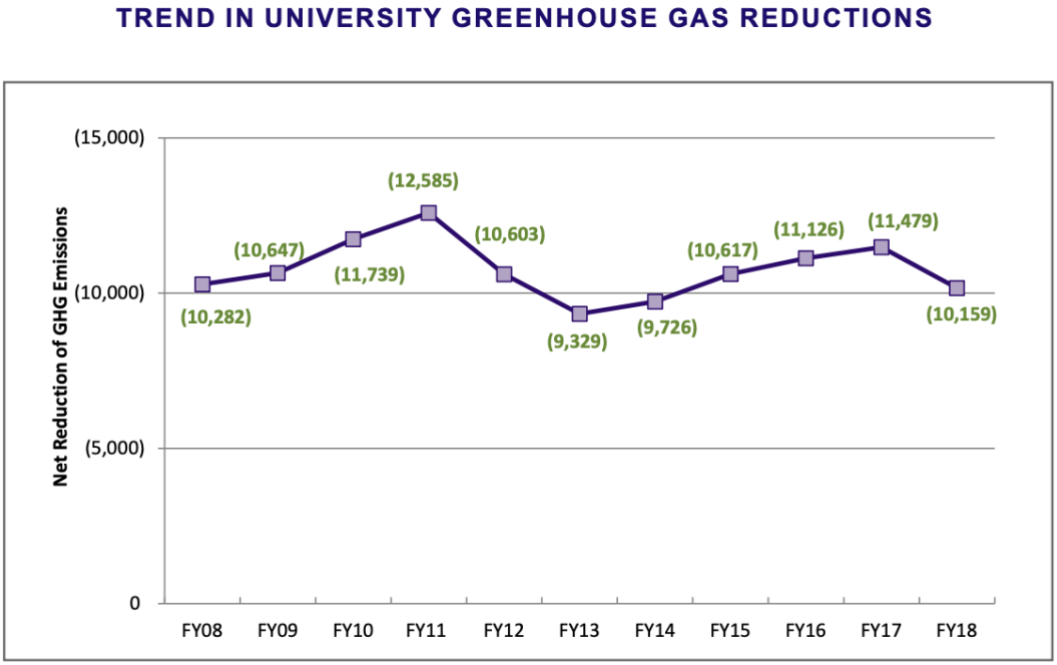

Figure 1 - Greenhouse Gas Emission over the years to highlight the importance of reducing items sent to the landfill[2]

Seattle uniquely adopted composting in 2004[3] and the program has grown significantly since then. In 2013, Seattle moved from 37% composting and recycling rate to a 61% rate[4], many cities are looking to Seattle as reference of what their city could be implementing to reduce their waste. Seattle's passion for the environment is made possible by its people. When former Mayor Ed Murray signed a law, making putting food into the garbage illegal, 74% of Seattle residents[5] supported the mayor's decision. In diverting more than 38,000 more tons of food waste[6,7] , the methane reduction provided both environmental benefits and economic benefits[8] through the improvement of soil health, increasing drought resistance, and through the reduced need for

[2] University of Washington. (2018). *UW Recycling Annual Report 2018*(Rep.). Retrieved https://facilities.uw.edu/files/media/uw-recycling-annual-report-2018.pdf
[3] Carel, J., McLaren, Brian, Franey, Nina, & Sutton, Sharon. (2015). Systems of Sustenance a Re-imagining of Seattle's Food and Food Waste Infrastructure, ProQuest Dissertations and Theses.
[4] Fry, E. (2013). Seattle Shoots for Zero Waste. *Fortune*,*168*(8), 26.
[5] Sewake, B. (2015, Jan 14). Let's talk trash Seattle. *University Wire* Retrieved from https://search.proquest.com/docview/2115332661?accountid=14784
[6] Seattle to fine residents for not composting. (2014, Oct). *Northwest Asian Weekly*Retrieved from https://search.proquest.com/docview/1609531467?accountid=14784
[7] Control (and compost) your garbage. (2014, Dec). *Northwest Asian Weekly*Retrieved from https://search.proquest.com/docview/1703533652?accountid=14784
[8] CARBON CREDITS FROM COMPOSTING. (2013). *Biocycle*, *54*(1), 17. Retrieved from https://search.proquest.com/docview/1730095124?accountid=14784

water, fertilizers, and pesticides[9,10], saving money. Methane is a more potent than carbon dioxide as a greenhouse and 16% of America's methane production is created by food waste[11] decomposing in landfills. Methane production could be significantly reduced by utilizing composting technologies. After the implementation of the law, enforcement was proven necessary as only 1/3 of the possible recycling or compost was being diverted[12] from the landfill. A fine and public shame[13] was given to violators to help Seattle get closer to their goal of zero waste. The fine was minimal, but the public shame included a red tag on your bin to show you had not separated your waste. With social and economic pressures, Seattle's landfills had the hope of being the last resort for people's waste. In the first month of the garbage inspections, the waste management employees flagged about 300 customers per day[14], which proves the effectiveness of the law as well as the lack of community surrounding composting.

A problem arose in April of 2016, in regard to determining amount of food waste in landfill bins. By enabling the waste management workers to inspect the waste was named an invasion of privacy by the attorney[15], who represented 8 residents of Seattle. At the end of the month, Judge Beth Andrus declared checking of waste unconstitutional[16]. The removal of the law removed the pressure to compost. Without this incentive, waste diversion, through compost, is completely reliant on an individual's efforts and drive.

The main composting facilities for Seattle are the two Cedar Grove Composting large-scale facilities. The facilities have been improved with Gore Cover system that can accommodate biodegradable plastics[17], which includes plastic bags, cups, and cutlery. The Cedar Grove

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[9] CARBON CREDITS FROM COMPOSTING. (2013). *Biocycle, 54*(1), 17. Retrieved from https://search.proquest.com/docview/1730095124?accountid=14784

[10] Carel, J., McLaren, Brian, Franey, Nina, & Sutton, Sharon. (2015). Systems of Sustenance a Re-imagining of Seattle's Food and Food Waste Infrastructure, ProQuest Dissertations and Theses.

[11] Idbid.

[12] Seattle to fine residents for not composting. (2014, Oct). *Northwest Asian Weekly*Retrieved from https://search.proquest.com/docview/1609531467?accountid=14784

[13] Severson, K. (2015, Mar 04). Starve a landfill. *New York Times (1923-Current File)* Retrieved from https://search.proquest.com/docview/2074297409?accountid=14784

[14] N/a. *Waste360 (Online)*, New York: Informa. Apr 18, 2016

[15] Idbid.

[16] Lacitis, E. (2016, April 28). Judge: Seattle trash-check ordinance 'unconstitutional'. Retrieved November 28, 2018, from https://www.seattletimes.com/seattle-news/politics/judge-seattle-trash-check-ordinance-unconstitutional/

[17] Goldstein, N. (2006). BIODEGRADABLE PLASTICS MAKE MARKET INROADS. *Biocycle, 47*(5), 46-48. Retrieved from https://search.proquest.com/docview/21177109?accountid=14784

Composting can conduct testing[18] on various products for a small fee, but also opens the door to new technologies and greater possibilities for waste diversion. At Cedar Grove, there is a well-defined process to ultimately convert food, biodegradable plastics, yard waste, and other compostable items to compost for soil. To decompose properly and create compost, it is necessary to introduce carbon, nitrogen, and inoculate (aged compost). Putting all of these components together, grinding them, separating contaminates, such as metals, and covering the pile with gore covers[19], the decomposition is made possible. The covering enables the facility to control the oxygen level and temperature, which helps to prevent the generation of methane when decomposing and kills pathogens[20]. After being processed once and for 46 days, the accidental plastic placed into the compost is removed and sent to the landfill. There is a state law in place to prevent contamination, such as plastic, in the compost that is greater than 1%.[21] The purer compost is replied and covered to decompose for another 46-day period. After 9 months of aging, this compost can be distributed to Seattle homes and positively contribute to its soil health.

Ironically, a positive development in waste management for Seattle is a new type of landfill. In the Fremont-Wallingford area[22], a more community friendly landfill, also very expensive landfill, was implemented in 2016. Surrounded by a park, the smell and noise pollution are contained predominately underground by a LEED Gold-certified[23] facility. The limitations of this facility are ultimately are its methane production[24] and its limited lifespan of 50 years[25], promoting the idea that landfills are not the sustainable choice in Seattle. In the decommissioned landfill in South Seattle[26], the concerns that arise are contamination of ground water and concern

[18] Goldstein, N. (2006). BIODEGRADABLE PLASTICS MAKE MARKET INROADS. *Biocycle, 47*(5), 46-48. Retrieved from https://search.proquest.com/docview/21177109?accountid=14784
[19] Donaldson, P. (Zero Waste.). *Where Does My Compost Go?* Speech, Issaquah. Retrieved from https://vimeo.com/187855385
[20] Idbid
[21] Ibid.

[22] Kinney, J. (2016, Dec 06). New Seattle landfill doubles as eco-friendly community hub. *Next City.Org,* Retrieved from https://search.proquest.com/docview/1846445780?accountid=14784
[23] Idbid
[24] LONG-TERM ENVIRONMENTAL PLAN PROPOSED FOR PART OF SOUTH PARK LANDFILL SITE. (2017). US Fed News Service, Including US State News, p. US Fed News Service, Including US State News, Oct 31, 2017.
[25] Kinney, J. (2016, Dec 06). New Seattle landfill doubles as eco-friendly community hub. *Next City.Org,* Retrieved from https://search.proquest.com/docview/1846445780?accountid=14784

[26] LONG-TERM ENVIRONMENTAL PLAN PROPOSED FOR PART OF SOUTH PARK LANDFILL SITE. (2017). US Fed News Service, Including US State News, p. US Fed News Service, Including US State News, Oct 31, 2017.

for the soil, which may have traces of arsenic, lead, diesel, and oil, which limit the redevelopment of the 40-acre landfill. The possibility of contamination of waterways and soils cause the liability to remain with the City of Seattle[27] until the site is proven safe, making it a burden to the city if any waterways are contaminated by the site. The burden of landfills was removed from local areas, as the City of Seattle established a partner Columbia Ridge Landfill in Oregon.

The main landfill used for Seattle is the Columbia Ridge Landfill[28]. This landfill is located outside of Washington State in northern Oregon. It has been open since 1990 and has a remaining life span of 142 years[29]. All of the landfill waste generated in Seattle is shipped by rail to Oregon. Seattle sends 300,000 tons of trash[30] to Columbia Ridge Landfill. This landfill is rather impressive at being sustainable, but its capacity is only decreasing. In order to protect the soil and ground water, Columbia Ridge utilized a 60-millimeter-high density polyethylene (HDPE) membrane to line the landfill pile[31]. The lining helps collect the dangerous leachate that comes from the decomposing waste and it is recirculated to improve the decomposition rate. Waste decomposing in landfill generates greenhouses gases, carbon dioxide and methane, which Columbia Ridge uses to power 12,500 homes in Seattle.[32]

Before being loaded onto a train, the landfill waste is first sent to a transfer station more locally. I had the opportunity to travel to the new transfer station in Fremont-Wallingford area. The garbage dumping building is seen more as a community center[33] for people to enjoy. There is currently an outdoor park under construction surrounding the facility. Even with all of the trash from surrounding areas, this transfer station has minimal smell and seemingly no noise coming from it. To build such a great facility, it cost the city $108 million[34], but contributes to the positivity around waste management in Seattle. It is LEED Gold-certified, has green roofs, has

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[27] LONG-TERM ENVIRONMENTAL PLAN PROPOSED FOR PART OF SOUTH PARK LANDFILL SITE. (2017). US Fed News Service, Including US State News, p. US Fed News Service, Including US State News, Oct 31, 2017.
[28] Columbia Ridge Recycling and Landfill. (2016). Retrieved from http://wmnorthwest.com/landfill/columbiaridge.htm
[29] Idbid.
[30] Why do we send our garbage to Oregon? (2015, February 6). Retrieved from https://atyourservice.seattle.gov/2015/02/06/why-do-we-send-our-garbage-to-oregon-2/
[31] Columbia Ridge Recycling and Landfill. (2016). Retrieved from http://wmnorthwest.com/landfill/columbiaridge.htm
[32] Idbid.
[33] Kinney, J. (2016, Dec 06). New Seattle landfill doubles as eco-friendly community hub. *Next City.Org*, Retrieved from https://search.proquest.com/docview/1846445780?accountid=14784
[34] Idbid.

solar panels, has permeable pavement (great for rainfall), and is made out of recycled materials[35]. I had the pleasure of going into the community center, which overlooks the dumping floor. There were games and toys set up to mimic the process happening in the facility. At the time I was there, there was a family playing and enjoying themselves. It is a great opportunity for community members to learn more about waste management and Seattle's efforts. I have included a few photos from my visit below.

Figure 2 - At the Wallingford-Fremont transfer station, this image is of the dumping floor.

Figure 3 - This photo is of the outside of the Wallingford-Fremont transfer station

[35] Kinney, J. (2016, Dec 06). New Seattle landfill doubles as eco-friendly community hub. *Next City.Org*, Retrieved from https://search.proquest.com/docview/1846445780?accountid=14784

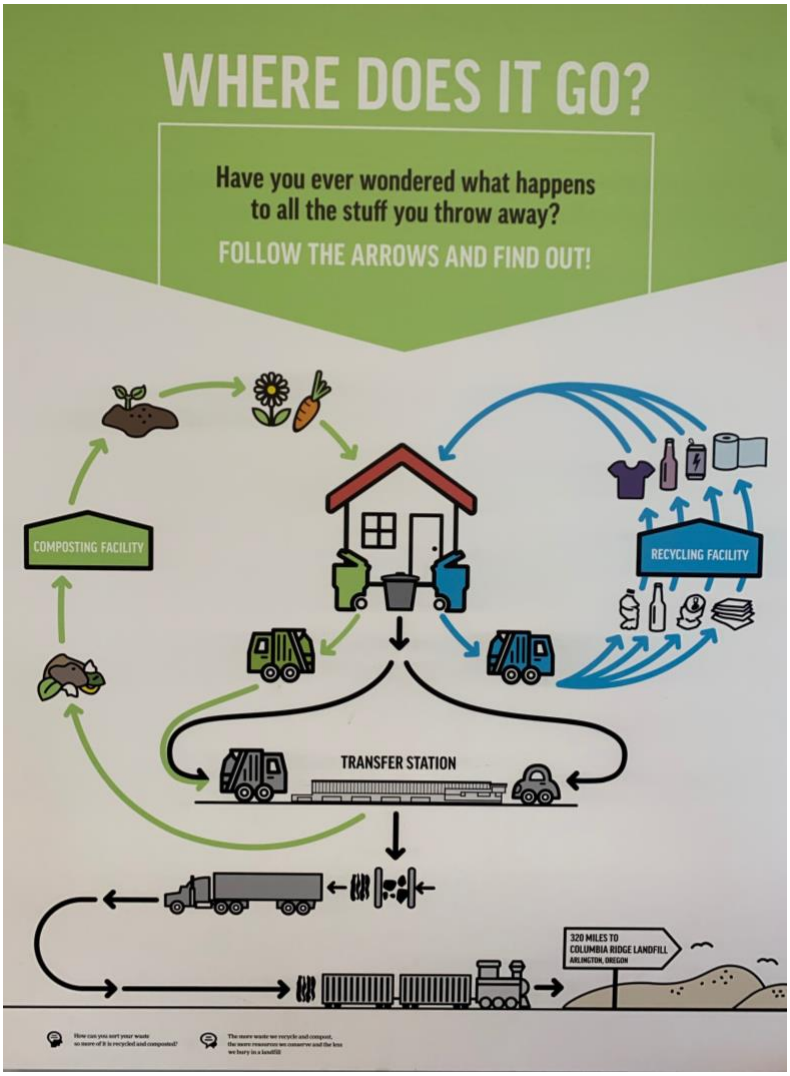

Figure 4 - A poster located in the Wallingford-Fremont transfer station, explaining the pathways of one's waste

There have been a few setbacks to bringing the City of Seattle to zero waste. January 1st of 2018, China banned various types of plastic and paper as well as increased their standards on the recycling they accept from the City of Seattle[36,37] along with many western countries and cities. The plastic industry alone for China is worth $284 billion[38] and is growing. China had various reasons behind their decision to reject a successful industry in their country. There is some concern for the morals of the recycling companies in China, as there is a push to increase

[36] Albeck-Ripka, L. (2018, May 29). Your Recycling Gets Recycled, Right? Maybe, or Maybe Not. *The New York Times*, Retrieved from www.nytimes.com
[37] de Freytas-Tamura, K. (2018, January 11). Plastic Pile Up as China Refuses to Take the West's Recycling. *The New York Times*, Retrieved from www.nytimes.com
[38] Wang, J. (2013). The Top Ten Issues Facing China's Plastics Recycling Industry. Plastics Engineering, 69(8), 42-49.

transparency[39] in the industry. With questionable processes, there is a massive impact on the natural environment within China, specifically in waste water, waste gas, and waste surrounding[40] the processing plants. The lack of environmental care surrounding the plants has caused new regulations on who can import scrap plastics. Only plants that meet environmental requirements will be allowed to import and unfit businesses will be shut down[41] to reduce pollution. Alongside problems with contaminated recyclable materials, due to the limited regulations initially in place, China has problems with unintentionally importing electronic waste with unregulated recyclables[42]. E-waste is more harmful to both the natural environment and the people living in close proximity to the facilities, impacting social justice. Illegal imports are a large problem in China, particularly in regard to other countries' waste. Individuals within Seattle should strive to meet the new standards set by China, by properly sorting their clean recyclables.

As standards increase for recycling, it becomes easier for contamination to be a problem[43] within a bag of recycling, emphasizing the need for improved efficiency and education on where exactly a piece of trash goes. If a dirty yogurt container is thrown in a clean bag of recycling, that bag of materials becomes degraded and less valuable[44,45] to the foreign market. This contamination is one of the many reasons China decided to halt their import on various products. With China's new barrier to recycling, The New York Times, is recommending people to make recycling a last resort[46] in order to create a sustainable society.

Because of the reduce market value, Republic Services, King County's recycling facility, has lost a substantial amount of income as the price paid for recyclables has dropped from $97.50 to $5 a ton[47]. The contamination remains even with a series of screens, blades, scanners, fans, air jets,

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[39] Wang, J. (2013). The Top Ten Issues Facing China's Plastics Recycling Industry. Plastics Engineering, 69(8), 42-49.
[40] Idbid.
[41] Idbid.
[42] Idbid.
[43] Op-Ed: Yes, Seattle University "Recycles" but We Need to get Better At it. (2018). *University Wire*, p. University Wire, Mar 7, 2018.
[44] Idbid.
[45] Albeck-ripka, Livia. "6 Things You're Recycling Wrong." *The New York Times*, The New York Times, 29 May 2018, www.nytimes.com/2018/05/29/climate/recycling-wrong-mistakes.html?action=click&module=RelatedLinks&pgtype=Article.
[46] Albeck-Ripka, L. (2018, May 29). Your Recycling Gets Recycled, Right? Maybe, or Maybe Not. *The New York Times*, Retrieved from www.nytimes.com
[47] Romano, B. (2018, March 29). Some Seattle-area recycling dumped in landfills as China's restrictions kick in. *The Seattle Times*, Retrieved from www.seattletimes.com

magnets, and people, which separate the goods and remove non-recyclables, showing the inefficiencies of the recycling program. With a drop-in value of these products, the company has petitioned to send recyclables to the landfill as going over capacity is both a safety and health risk[5] for the surrounding area. Through improved education paired with behavioral change, Seattle's efficiency and cleanliness of recyclables could be improved to the new Chinese standard, increasing the value and making recycling profitable.

Cascade Recycle Center receives recyclables from the North Transfer station, or the Wallingford-Fremont transfer station. Before the recycling is dumped, trucks are weighed to judge their contents. First, the recyclables are presorted, where people remove garbage or other non-recyclables. Then the separated recyclables are sent along a conveyer belt where they pass through various separators: large disks for cardboards, small spinning disks for newspaper, rotating disks for mixed paper, magnetic belts for steal, and finally an optical sorter. An optical sorter that recognizes plastics and separates them with an 98% accuracy[48]. After moving through the system, people check the accuracy of sorting and pull out any misplaced items and removing contamination or contaminated items. Separated recyclables are sent to their perspective facilities to be processed in bailors. 3% of steel is sent to Arrow Metals in Woodinville. 1% of aluminum cans are sent to Tennessee. 16% of glass is processed locally. Finally, 3% of plastics are processed in either Bakersfield, CA or Merlin Plastics, British Columbia[49]. Recycling is a very complex system, as it involves so many different types of recycling.

Looking specifically at the waste generate at the University of Washington, through the University of Washington Waste Characterization Study, the majority of the university's waste is sent to the landfill. In Figure 5, it displays the distribution of waste in four different bins, compost, recycling, garbage/landfill, and combined fiber[50]. The term combined fiber means paper or cardboard waste collected separately from other recyclables. Combined fiber waste is a significant amount of waste generated by the university, but it was not analyzed by this waste

[48] Wmnorthwestcom. (2013, December 23). Cascade Recycle Center - crc2. Retrieved from https://www.youtube.com/watch?time_continue=245&v=J7WeFK3dKF4
[49] Idbid.
[50] Cascadia Consulting Group (Ed.). (2018, July). *University of Washington: Waste Characterization Study* (Rep.). Retrieved https://facilities.uw.edu/files/media/uwwcs-2018-report-final.pdf

study. Based on Figure 1, there is a need for improvement in waste diversion to reach sustainability goals for the university.

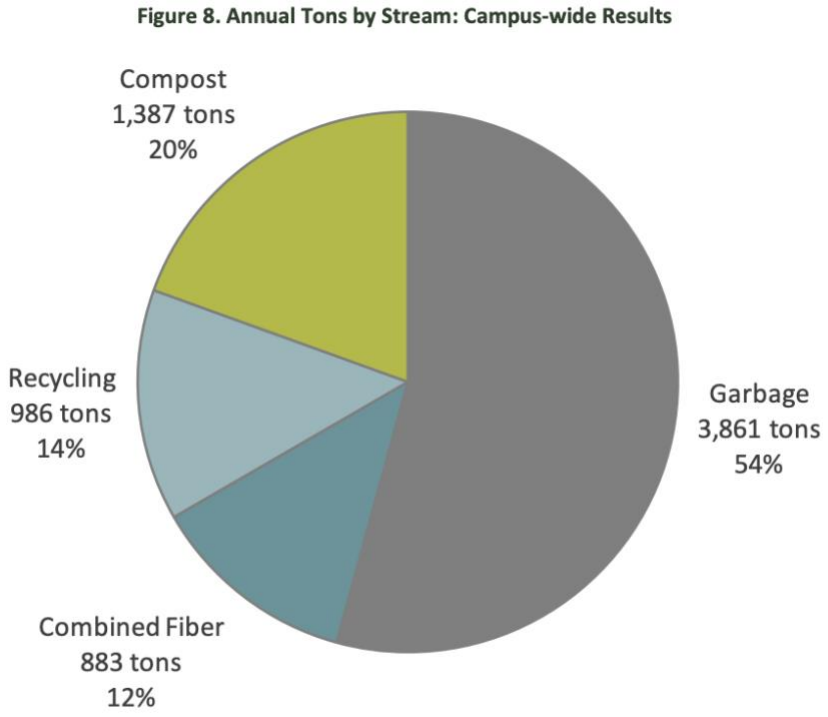


Figure 5 - Shows the total amount of waste over the course of a year generated at the University of Washington based on amount placed in each bin. [51]

To supplement Figure 5, Figure 6 actually shows specific waste characterization. Figure 5 is a more broad and general sorting based off the initial findings in the various waste bins around campus. Figure 6 unpacks and uncovers what is actually thrown away in the bins. It is shocking that 62% of the items placed in the landfill bins are recoverable and improperly sorted. Both number of items recycled and composted can be doubled, while the landfill waste can be reduced by nearly two-thirds. Taking an even closer look at the recoverable waste in the landfill bin, it seems that the largest recycling contributor is paper[52]. Paper is both compostable and recyclable, meaning that it is 100% unnecessary to place in the landfill bin. Based on the graphic, it appears that paper is not included as a compostable item in recycling and landfill bins.

[51] Cascadia Consulting Group (Ed.). (2018, July). *University of Washington: Waste Characterization Study* (Rep.). Retrieved https://facilities.uw.edu/files/media/uwwcs-2018-report-final.pdf
[52] Idbid.

Moving to the recycling contamination from other materials, 14% of the contaminates are compostable[53]. The high contribution from compostable items shows the errors in clean recyclables. The high percentage of total contamination of recyclables at 26% clarifies why China no longer wants our recyclables. If the university were to give our recyclables directly to China, they would be rejected immediately as contamination can only be less than 0.5%.

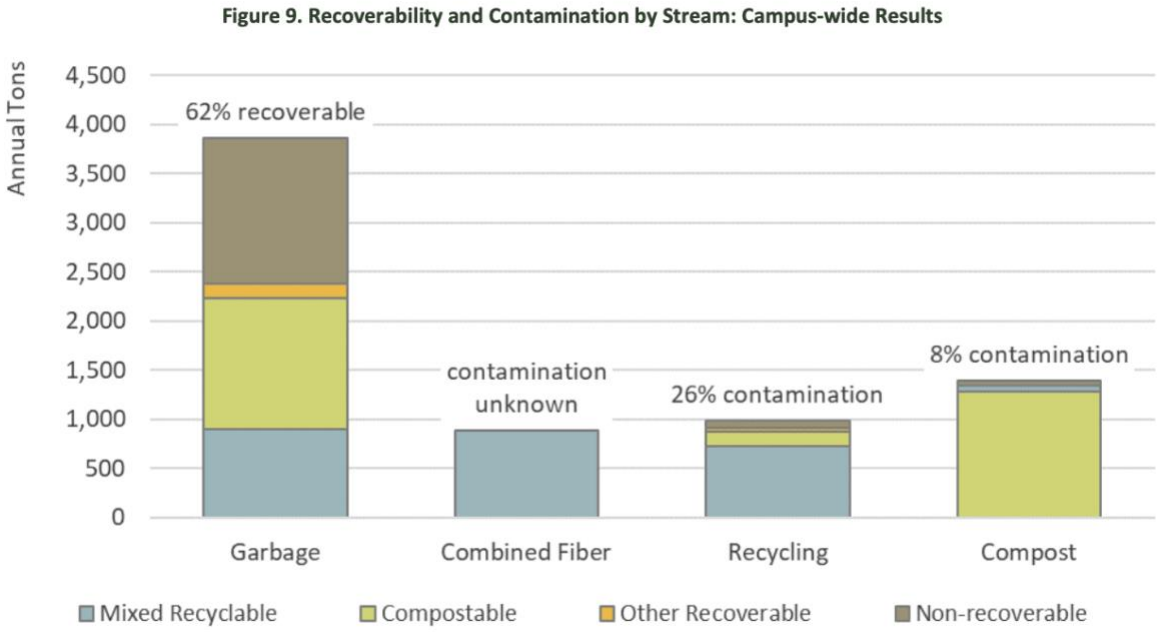


Figure 6 - Shows a breakdown of the various sections in Figure 1. For this study, the University of Washington determined the efficiency and accuracy of sorting in bins. [54]

Table 1 - This table lays out the lifecycles of well-known recyclable items, highlighting why recycling is valuable to our society.

Recyclable item[55]	Time in landfill	Time in recycling
Glass bottles	1 million years	6 to 10 days
Aluminum can	100 to 500 years	2 months
Plastic bottle	100 to 500 years	1 week
Newspaper	2 months to 50 years	1 week
Paper containers	2 months to 5 years	1 week

[53] Cascadia Consulting Group (Ed.). (2018, July). *University of Washington: Waste Characterization Study* (Rep.). Retrieved https://facilities.uw.edu/files/media/uwwcs-2018-report-final.pdf
[54] Idbid.
[55] Association of Municipalities of Ontario. (n.d.). How long does it take? Retrieved from https://www.amo.on.ca/AMO-PDFs/Waste Management/Recycling/How_Long_Does_It_Take-2015-09-28.aspx

Once people recognize the problem of contamination, it decreases the positivity of recycling. It is necessary to look at Table 1 and recognize why recycling is so valuable. It is necessary to emphasize the need to reduce contamination, but it is also required to understand the purpose of recycling. That purposing being to reduce use of raw materials and to create a sustainable society that can survive in the future.

Looking at contamination in composting, this is the most accurate process at UW with only 8% contamination. Although this number is small comparatively, there is still room for significant improvement, in order to lessen the burden on Cedar Grove composting facilities. There are more mitigation measures in place at the composting facility, but the facility only has the capacity for a few mistakes, contrary to capacity of recycling facilities.

The largest contaminate in compost is recycling. Especially with plastic like compostable containers, it has become confusing whether or not plastic is compostable. The problem with plastics or paper coated in plastics is that it reduces the quality and value of the compost. Plastics are broken down into microplastics. These microplastics negatively impact organisms in the ecosystem, never leave the natural environment, and are easily spread[56]. This highlights a problem that can arise if waste is sorted improperly. A system that strives to help the environment becomes a system that harms our surrounding natural environment.

This waste diversion study, conducted by Cascadia Consulting Group and the University of Washington, lead to reflection on the signage around bins. By understanding the accuracy of community members with sorting their waste, UW recycling determined ways to improve their educational tactics to increase their waste diversion. Looking at the ideas introduced by the non-profit, Recycle Across America, UW gained simplistic signage ideas to place above bins. The main emphasis of the non-profit is to reduce confusion by standardizing signage and not overwhelming people.

[56] Bailey, K. (2016). Microplastics in Compost: What We Found and What You Need to Know. Retrieved from http://www.ecocycle.org/microplasticsincompost/faqs

Although the ideal diversion of waste is reducing overall consumption, society is far away from a low consuming culture, so improved waste management is a realistic approach to methane production and landfill piles. By increasing transparency in Seattle's waste management programs, citizens will better understand where exactly their waste and will be more conscious in sorting their trash, playing into the idea that success is dependent on public compliance[57].

[57] Sewake, B. (2015, Jan 14). Let's talk trash Seattle. *University Wire* Retrieved from https://search.proquest.com/docview/2115332661?accountid=14784

Methods

My project is predominately gathering, and synthesizing information researched. Research is the most essential part of my project, as it enabled me to gather information about the various pathways of waste and types of signage. I gained valuable information from university databases and newspaper articles. With contamination being a current event, it was easy to find newspaper articles covering the transition of recycling processing. Contamination causes many problems in recycling and compost processes and it became a focus of my project. With the change in regulations with Chinese recycling, I do not believe that the United States was prepared for the restrictions and change. It will be interesting to see how the problem with recycling develops in the near future.

I extended my research to signage, in order to better understand an individual's interaction with their waste. UW recycling gave me resources to further my understanding in their decision for signage usage. With a goal to present more simplistic signage, I began to rethink the goal of my poster. Redeveloping the goal of my project helped me to better understand my original goal. That being said, my poster developed into an educational tool rather than my initial intention of a poster for placement above the waste bins.

Throughout my project, I was in contact with UW recycling. UW recycling was an excellent resource for clarifying information about UW's own waste management, and for pointing me in the direction of valuable resources. Although I never formally met with members from UW recycling, I exchanged several emails and spoke with members at university-wide events. From the UW recycling program, I learned about the opportunity around earth day named *Trash-In*. UW recycling collected all landfill bins across campus and emptied their contacts onto tables. With the waste laid out on tables, students had the opportunity to properly sort every piece of trash that ended up in the landfill bin. This event prevented 57% of the landfill waste from making it to the landfill.

At the Trash-In event, located in Red Square at the University of Washington with two other members of CEP, Jenna Brewington, Sydney Solis and me (from left to right).

After gathering a sufficient information about the various processes of waste management in Seattle and where it goes beyond the city, I explored the pieces of waste that I wanted to focus on for my final poster. I chose four different pieces of waste: a plastic water bottle, compostable plastic, a tea bag, and plastic wrap. I decided to focus first on following the pathway of a plastic water bottle through recycling, landfill, and compost. I chose a water bottle to emphasize the need to switch to a reusable water bottle. I really applaud the water bottle culture at the University of Washington; I only hope that this reusable culture can extend to coffee cups and beyond. I also believe that even more people apart of the university community can switch to reusable water bottles. With the poster, I hope to educate individuals to truly understand what happens to their water bottle and its success level of being recycled.

After choosing to focus on a water bottle, I immediately started working with InDesign and Illustrator to format my poster. This was extremely difficult as I did not know to use InDesign or Illustrator. My advisor, peers and mentor all told me to draw my ideas on paper prior to using the computer programs. Drawing my ideas on paper gave me time to learn InDesign and Illustrator, while simultaneously working on my poster design. Once my drawings were complete, I went back to InDesign and Illustrator and was more successful in creating a design that I was happy with in the end. It was beneficial to learn that I did not need to handcraft each icon, but utilized a great website called *Noun Project*. Noun Project saved me a great deal of time and helped to make my poster more professional.

With a final product, I reached out to my advisor, professors, peers, and mentor for feedback. I gained a great amount of feedback and reworked my project. I took all the feedback and tried to take all the recommendations that benefited my overall product. I exchanged new versions of my poster several times, until I was satisfied with the poster. These exchanges and edits took more time than anticipated. Initially, I had a goal of completing at least four posters, but due to various constraints, timing being the main constraint, I only completed one final poster. I found it was more beneficial to have one detailed poster that I was proud of rather than several posters that were okay.

Along with completing my posters, I was required to create an advertising poster. The poster focused on the water bottle as well. The poster can be viewed in the appendix. I also synthesized my results and overall project action items by writing a final report. The report has helped me understand and recognize my efforts this year. I believe that completing a literature review first would have been more beneficial if it was completed during winter quarter. My research expanded throughout the creation of my posters, filling in the gaps in knowledge. I believe I will continue to learn about waste management, as it has become integrated into my daily life as well as apart of my sustainability drive. Educating individuals on environmental mitigation techniques is a new interest I have that will continue to grow. While I work to educate others, I continue to learn and educate myself.

Final Product

After receiving feedback from my professors, peers, and mentor, I created my final product, a poster. The poster follows the pathways of a plastic water bottle through the recycling, landfill, and compost bins. The poster follows the potential processing of a plastic water bottle, step-by-step. A plastic water bottle is the focus of the poster because it is well recognized as recyclable and is an unnecessary waste item. The ideal pathway of the plastic water bottle is not one of the three bins, but not using it in the first place, beginning by reducing consumption.

The recycling pathway is specific to the plastic water bottle, as each type of recycling has a specific path; it is also the most complex path. Following the plastic water bottle from the University of Washington to the Cascade Recycling Center to either China, California, or British Columbia. The water bottle is first separated from all recyclables and then shipped as a collection of plastic to most likely China, as China receives 97% of plastic water bottles. Once this water bottle reaches China, as of 2018, there is a new obstacle in its way of being properly recycled, contamination. Contamination is due to improperly sorted waste. In recycling, contamination is anything non-recyclable in the recycling bin. China's new standard requires contamination to be less than 0.5%. Highlighting in the poster that contaminated items are sent to the landfill, there is hope people will work on recycling only clean recyclables. It is disappointing that nothing is in place to clean contaminated items to increase amount of materials recycled. By laying out the complex system of recycling, it reduces the positivity of simply recycling the plastic water bottle and encourages the use of a reusable water bottle.

Differing from recycling, both compost and landfill are processed locally. Landfill pathway is the most simplistic and never changes. All the landfill bins are collected at the transfer station and sent by rail down the Columbia Ridge Landfill, located just passed the Oregon border. Everything ending its life in a landfill decomposes at various rates. A plastic water bottle can take anywhere from 100 to over 500 years to decompose. The greatest fault of plastics is that it never completely decomposes, as all plastic created is still on this Earth, just in the form of microplastics. The landfill is not the worst place to dispose of a plastic water, however, it is inferior to repurposing the plastic.

The worst bin to place your plastic water bottle is the compost. For purposes of showing the consequences of improperly sorting one's waste, I followed the path of a plastic water bottle being accidentally placed in the compost bin. Regardless of the fact that the compost goes to the same transfer station as the landfill bins, the bins do not interact, preventing further separation and fixing of improper sorting. Once at Cedar Grove industrial composting facility, the plastic water bottle undergoes 46 days of decomposition through the composting process. It is broken down, shredded and embedded in compost, plastic pieces greater than 12 millimeters are blown out and sent to the landfill. Smaller pieces remain in the compost and are processed into the compost that goes into gardens. After going into gardens, microplastics negatively impact the natural environment and people, who can potentially consume the microplastics in their produce gardens. This shows that compost is beneficial to the natural environment, but only if it is done successfully with limited contamination.

Based on what I learned about various signage around waste bins, I do not believe that my poster would have value above waste bins. The current standard for signage above bins is simplistic. My poster is not simplistic and does not direct a person on where their waste must go, meaning it would add confusion if it is placed above the bins. I believe that my poster would be best used as an educational tool rather than standing alone. The poster proves that all three processes, recycling, composting, and dumping in the landfill, are complex. The poster should facilitate discussion on how waste management can help mitigate climate change as well as show the impact of human action. There are various ways that one can help reduce the impact they have on climate change, and diverting waste is one of those ways. With curbside pickup available, the City of Seattle facilitates people's ability to reduce their individual impact on the natural environment.

Recommendations

- ⇒ STOP using single-use items, especially plastic
- ⇒ Increase education about waste and begin educating people at younger ages
- ⇒ Increase items recycled is to separate glass, paper, and aluminum from plastics to reduce contamination
- ⇒ Standardize compost and recycling across the United States to reduce confusion

Analysis of Results

The most difficult pathway to follow is recycling. Overall, there is a lack of transparency with the recycling processes. No city wants to admit how much of their recycling is actually recycled. Also similar to individuals, recycling facilities fuel ideal recycling. That being said, they get paid for the weight of recycling, so they ship and get paid for contaminated recyclables. Due to this lack of diligence, the new standard for China's acceptance of recycling was put in place. "Going green" is emphasized and encouraged, but at what cost? Seattle's contribution to the problem is not defined, pointing to the lack of transparency in recycling. This lack of transparency still leaves me with many questions, one of being: how contaminated are Seattle's recyclables specifically?

Beyond the local processing of recycling, China does not have a defined recycling process available. There are several resources that emphasize the need to develop a greater understanding of the impact, however, there are no studies finalized. Clearly, there is resistance to the impact of these recyclable processing facilities, as air quality and landfill capacity are all being impacted by foreign waste. That being said, there is currently no alternative, and nothing put in place to compensate for the reduction of recycling ability. So, what is next for recycling?

Recycling needs to change.

Reflecting on the recycling process as whole, far beyond Seattle and my scope, I believe that the entire process needs to be reworked. Facing rejection with China and now other third world countries, the United States must find a way to internally handle their own waste. In handling recyclables locally, people's requirement to limit contamination will be set to a higher standard. Possibly this higher standard can include regulations and laws that enforce and ensure the success of the local recycling program. By local, I mean here in the United States. That being said, processing locally may have a negative impact on low income areas, as unwanted processing plants tend to be placed in areas surrounded by people who cannot afford to protest or move away. Is this any better than shipping recyclables abroad? I believe it is beneficial to have a local impact as it provokes change, when it brought to our own backyards rather than across the globe.

Besides processing internally, I have thought of another way to reduce contamination. From my own experience, I have found that plastics are the most contaminated recyclable on average. That being said, I believe that we should stop allowing plastics to be recycled. A less extreme change could be making plastic be required to be separate from glass, paper, and aluminum. I would favor not accepting plastics at all, in order to reduce the feeling that recycling is benefiting the environment. Extending upon that idea, recycling is positive, however, it is inferior to a zero-waste culture. By taking away individual's ability to recycle plastics, guilt in consumption can be created. Also, plastic is more difficult to recycle than any other material, as aluminum and glass are 100% recyclable with no degradation of their material value. Paper's value is degraded; however, it can be composted at the end of its life, eliminating it from the landfill. Eliminating recyclable plastics emphasizes the idea that plastic water bottles are an unnecessary waste item, as mentioned in the creation of my poster. By no longer accepting plastic as recyclable, recycling can successfully become processed locally and contamination can be reduced. With a reduction in contamination, the processes can become more efficient and more successful.

Based on the waste characterization study conducted by the University of Washington, the distribution of waste is disheartening. With paper as the main contributor to recyclables in the landfill, it is concerning that the most well-known recyclable is still improperly sorted. This could be due to the convenience of placing items into the landfill bin. With a significant amount of paper going to the landfill, I begin to question if education is the only solution to improving the accuracy of sorting waste. That being said, I believe that creating an understanding of one's impact when throwing an item away will provide greater accuracy in sorting. Many people rely on the idea that they have no significant impact, but by educating individuals on their collective impact can lead to change.

Moving further beyond recycling plastic, based on my research, I believe that reducing the overall production of plastic can significantly benefit the wasteful and single-use culture that is dominating the United States. It would be great to see regulations on plastic used in packaging. This has already begun with several cities eliminating the use of plastic bags. This is a very small step that is attempting to tackle an immense problem facing the entire globe. The overall end

goal for waste management is to not exist. The difficulty with establishing a zero-waste community is that no community is isolated. It will take change across the country and even the world to significantly reduce the impact that we have on our natural environment, which is seemingly an impossible feat. With anything revolving around climate change, it is important to remain positive and recognize that your individual actions DO make a difference, regardless how small. Creating a positive environment of societal change will ultimately create a sustainable world.

Beyond the processing of waste, there is also a loss of clarity with individuals in Seattle. This means that the recycling and compost process is forever changing on what is accepted. Confusion increases the amount of contamination in the various bins. Not only do the standards of recycling and compost change, but the signage changes as well. UW has recently implemented new signage; however, I believe that signage only has a small influence over the success of sorting. I find that educating on waste bins in a school setting, preferably at a young age and as standards change, is superior. I believe that signs can only say so much, and at UW simplistic signs say very little. To gain knowledge of the bigger picture, individuals only need signage as a crutch. Also, if people do not understand why they should sort their waste, they will not take time to look at a sign.

Various universities and the non-profit, Recycle Across America, propose that simplistic signage is beneficial to individuals sorting their waste, but I have trouble accepting it. I believe that the source of error for sorting one's waste is due to lack of knowledge and understanding. I believe that people are confused but want a clear picture of what piece of waste goes where. That being said, I do think reducing the number of images on a poster by eliminating commonly known items from the pictures is helpful. Another benefit from the waste characterization study could be recognizing commonly misplaced items in any of the three bins and changing the signage accordingly. I believe simplistic signage can prevent individuals from being overwhelmed, but I believe that these signs should have more intentional thoughts behind them.

Although standards do change with waste management, my greatest frustration is the confusion with compost. Regardless of the fact that I did not know how to compost until I came to Seattle, I

learned. I believe that a significant amount of people do not know and do not learn how to compost. The reason I use the term confusion is because people continue to put food, soiled paper, and other common items into the landfill bin or recycling bin. With little prior knowledge, I find compost to be the most straight forward and the easiest bin to maximize. That being said, I do not believe that everyone would agree, so I would argue individuals need to be educated in school and at work, in order to reduce confusion.

Although the Columbia Ridge Landfill is well coordinate to prevent direct impact on the natural environment, a landfill should be the last resort for any piece of waste. Reducing infiltration of the soil and groundwater with leachate, the landfill proves to remove a significant amount of negative impact. The facility successfully increases the quality and success of the landfill by circulating the leachate and therefore increases the decomposition rate of the items of the waste; however, these pieces of waste take several of hundreds of years to decompose and recirculating leachate has limited capabilities. As for the production of greenhouse gases, Columbia Ridge harnesses the gases to power homes in Seattle. Even though they generate power for homes, these gases are unnecessary biproducts from decomposition. In diverting a majority of the waste to be recycled or composted, energy could be saved. By recycling, the consumption of raw materials is reduced, and less energy is consumed for a lower level of processing. By composting, the consumption of pesticides is reduced, and the stability of soil quality and heath is increased. Although Seattle has a positive relationship with a more sustainable landfill, across the United States and the globe, dumping grounds are more common. This shows the great strives that Seattle has made compared to other cities, but they still need to avoid reliance on the landfill.

A fascinating aspect of Seattle's waste management system is that both recycling and compost rely on an individual's ability to properly sort one's waste. Although they both have measures put in place to remove contaminates, their facilities can only do so much. This proves the reasoning behind my poster to create intentional individuals, who ideally successfully and properly sort their waste. In order to improve the efficiency of the waste management facilities, it is necessary for individuals to increase their sorting accuracy or facilities to take on the burden of resorting waste.

In the end, these posters strive to educate individuals to be more knowledgeable about where their waste goes after they throw it away. People must understand that one's waste continues to impact the natural world after it leaves one's curb. Through education about waste management, people become more intentional with sorting their waste, increasing waste diversion. By maximizing compost and recycling, a single piece of waste would follow a more efficient life cycle. With more effectively sorted waste bins, the overall efficiency of all three processes can increase. As contamination decreases across the waste management cycles, flaws and other errors are eliminated or reduced. Operating costs could be reduced with better time efficiency. These improvements of the waste management processes are all made possible by individual efforts. With my poster, I want to create people, who consciously sort their waste, by defining why it's beneficial to use all three bins properly.

What I Have Learned

Working on my senior project for the past year, I have learned a great deal about waste management in Seattle as well as about myself. For myself, I have learned that a project that extends over the course of a year is difficult and requires more time management than any project I have completed before. A yearlong project also requires the ability to grow in excitement. I believe that personally, I never lost interest in my project, I just became distraught when things did not go as planned. For a year, it is easy and necessary to diverge from the plan. The most frustrating part of my entire project was the inability to schedule a time to visit the facilities. With demanding time constraints for chemistry labs, I could not fit any visits into my schedule, except for visiting the transfer station in Wallingford. Failing to schedule visits, I wish I would have developed a point at contact to answer any questions and clarify parts of the process. I stopped myself from engaging with experts with fear I would sound uneducated or be a burden to the expert. Both of these arguments are invalid, but I wish I could have convinced myself this at the beginning of my project.

The most successful and beneficial action I did for myself was developing strong and helpful accountability partners. Not being able to have an accountability group during class time, I became nervous I would fall behind; however, the opposite proved to be true. I found that in class, accountability groups were not productive, but outside of class, Oskar and I were successful at maximizing our time together. With two very different projects, we bounced ideas off of one another and set time frames for each other. Having Oskar as my accountability partner greatly benefitted me fall quarter of senior project. With winter quarter, I was able to participate in the entire class time, which reduce the success of Oskar and I as accountability partners. Having class later in the day also made using class time less effective and productive. I believe winter quarter is where I struggled the most to stay accountable. Ending with spring quarter, Jasmine and I became accountability partners outside of class time and successfully met every Wednesday for all 10 weeks. By senior project night, we knew and understood one another's project nearly as well as our own and could practically give one another's presentations. Establishing weekly goals and deadlines for myself and developing a partnership, I more successfully developed my senior project.

While working on this project, I traveled to multiple cities within the United States, including Seattle, San Diego, Salt Lake City, and Quincy, as well as Whistler, Canada. All these cities have differing waste management strategies that I paid closer attention to than I had in the past.

Going home to San Diego for spring break and bringing friends from Seattle, it was painful to say that we do not compost. Compost is so accessible and integrated into the lives of people living in Seattle and surrounding areas, it is strange not every city adapts an industrial compost facility. San Diego will be directly affected by climate change, specifically sea-level rise, which begs the questions, why is the city not doing more action items to help mitigate climate change?

Salt Lake City has an interesting recycling requirement, as it excludes glass from its recycling program. My family friend said she used to drive all her glass to a facility, but then it proved to be too inconvenient and she stopped recycling glass all together. Not accepting glass seems strange, as it is easily processed, and its value is constant. On all the bins across the city, it clarifies that glass is not accepted. This shows that inconsistencies for recycling is common and creates another layer of confusion for visitors. Not having curbside recycling for glass shows the lack of drive people have to make the extra effort to recycle. It proves the value of curbside pickup offers for convenience of an individual. I believe this enhances and reinforces the value of my own poster as people do not fully understand what happens to their waste and the benefits of putting in effort to recycle. I believe if more people understood what happens when they do not recycle glass, they would not mind the inconvenience.

Looking at a city closer to Seattle, Quincy, located in central Washington, there is no option other than landfill for one's waste. Spending a weekend in Quincy after dedicating an entire year to the waste management process, I was hurt. If two hours away from Seattle, there is no action for waste diversion, how can Seattle positively influence the rest of the country? Central Washington and Seattle need to extend their engagement and overcome various environmental issues together. Putting the benefit of waste diversion into perspective for the specific areas can evoke change. One idea is that because farming dominates that area of Washington, placing emphasis how their jobs are as stable as the well-being of the natural environment, people can see a greater need to change. Similar to the impact that climate change will have on San Diego,

there will be a different, but just as great of an impact on Central Washington's livelihood if the climate changes in the area. Looking past individual action, I believe that there should be more government level interaction to extend the reach of waste management and waste diversion. With Seattle as a powerhouse for Washington State, Washington State has the ability to, as a state, divert most of their waste and reduce their contribution to climate change.

Turning to countries other than the United States, in British Columbia, Canada, they offer composting as an option. Even outside of the city of Vancouver, in Whistler, industrial composting is available. Removed from the general population, this ski resort makes an effort to increase their waste diversion, which cannot be said about a number of large cities. If a small isolated community can support an industrial compost, why can a successful city not?

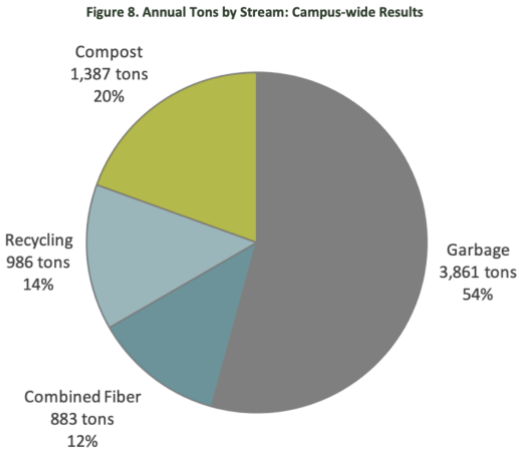
In the end, I have spent the past year critiquing the waste management services of Seattle, they are a leader in waste management. Simply by having both curbside compost and recycling pick up, they out perform a majority of the United States and the rest of the world. Seattle still has a long way to go to reach their waste reduction level, but they are significantly closer to tackling waste diversion. The city offers great guidance for other cities with high aspirations to combat climate change and the impact of their individual city.

I have learned that there needs to be more cumulative effort to take actions against the production of greenhouse gases. I also learned that I will never look at trash the same. I constantly pick out various items from each bin and put it in another. I am taking matters into my own hands, while simultaneously educating my close friends. I have a new appreciation for the waste management system and have developed a new passion for sorting waste. I hope to see the actions of Seattle spread to the rest of the country. I also hope that education about contamination in recycling is spread to enable our recyclables to be processed. I have high hopes for society and their waste disposal. The ultimate dream would see the transformation of society from a single-use society to a sustainable society.

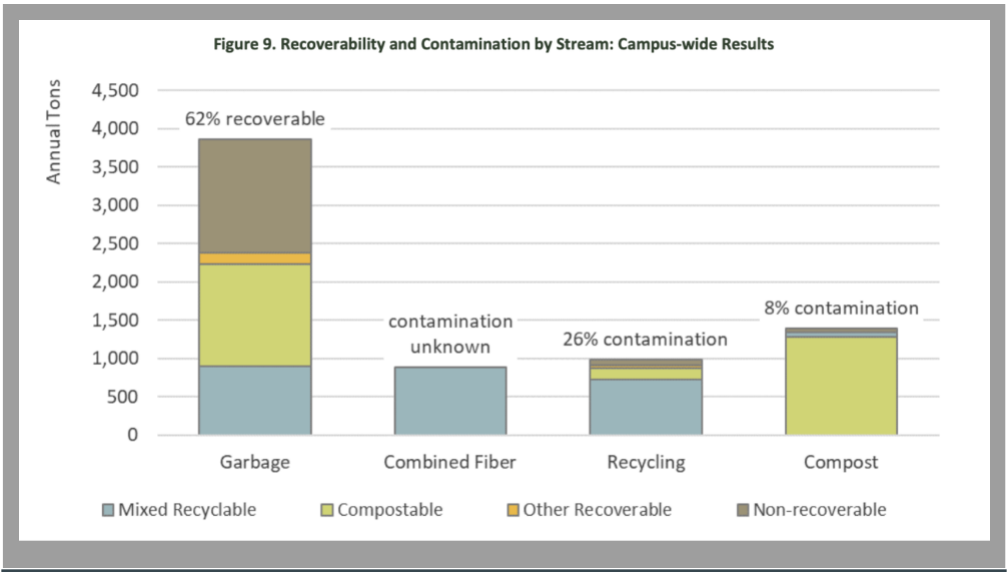
Appendix

Advertising poster – made for senior project to gain a larger audience

Presentation for Senior Project Night on May 16, synthesizing the results of my project

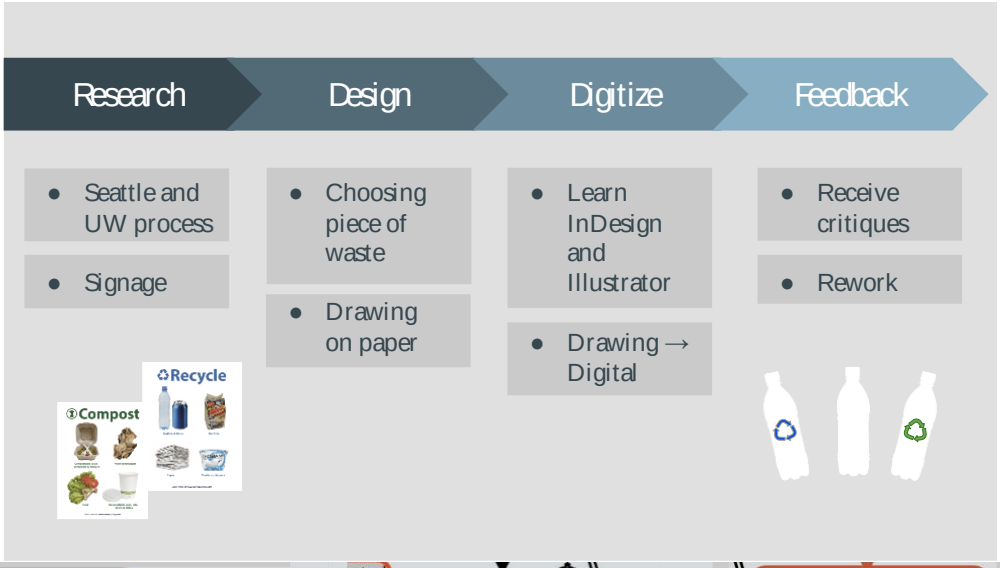


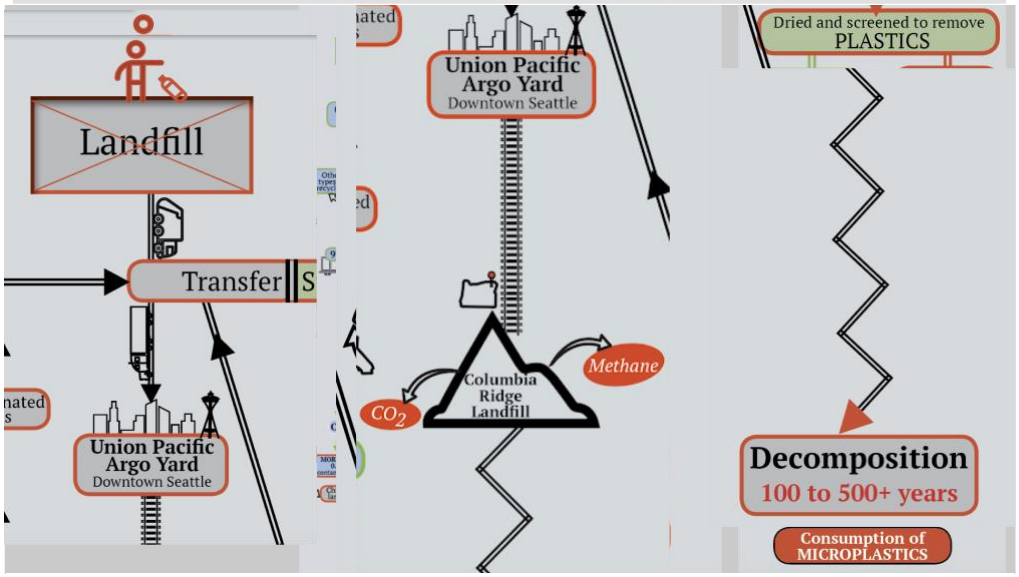
University of Washington Waste Characterization Study 2018



I Have Learned

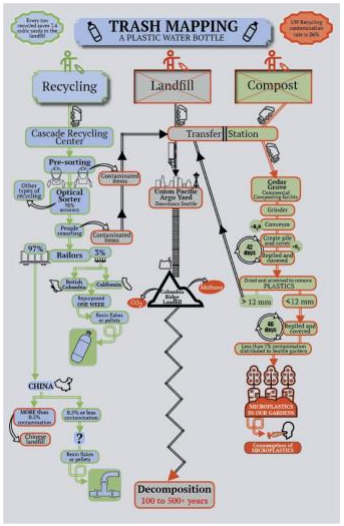
- Trash-in opportunity
- Can**not** recover recycling - highest contamination
- Why not compost?
- Best to not use any bin - **REDUCE CONSUMPTION**





These posters can...

- Promote intentionality
- Increase waste diversion
- Improve the efficiencies of cycles



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