



CITY OF AUBURN

Current Food Waste and Potential Food Rescue Programs for the Auburn School District

○ ○ ○ ○ ○ ○ ○ ○ ○

University of Washington ○ School of Public Health
School of Public Health 491/492: Public Health Capstone

Instructors: Deb Hinchey ○ Jennifer Otten

Report Author: Courtney Schupp

Spring 2017

SPECIAL THANKS TO:



Kathleen Edman, City of Auburn Solid Waste Division • Joan Nelson, City of Auburn Solid Waste Division • Erin Hislop, on behalf of the King County Green Schools Program and the City of Auburn • Dale Alekel, King County Green Schools Program • Scott Weide, Auburn School District.

This research used statistical consulting resources provided by the Center for Statistics and the Social Sciences, University of Washington.

Students of SPH 491/492: Athena Anderle • Anna Beebe • Suet Ellen Chau • Joseph Gunnar Colleen • Joan Kim • Jenny Luong • Ryan Poll • Katie Schroeder • Daniela Vega

CURRENT FOOD WASTE & POTENTIAL FOOD RESCUE PROGRAMS FOR THE AUBURN SCHOOL DISTRICT

About Livable City Year	04
About the City of Auburn	05
Executive Summary	06
Introduction	08
Methods	14
Results	20
Interpretation of Results	32
Conclusion	40
References	42
Appendix A	46

This report represents original student work and recommendations prepared by students in the University of Washington's Livable City Year Program for the City of Auburn. Text and images contained in this report may be used for not-for-profit purposes. For citations please consider: Livable City Year 2017. Current Food Waste & Potential Food Rescue Programs for the Auburn School District. University of Washington, Seattle, WA. Prepared for City of Auburn.

ABOUT LIVABLE CITY YEAR

The UW Livable City Year program (LCY) is an initiative that enables local governments to tap into the talents and energy of the University of Washington to address local sustainability and livability goals. LCY links UW courses and students with a Washington city or regional government for an entire academic year, partnering to work on projects identified by the community. LCY helps cities reach their goals for livability in an affordable way while providing opportunities for students to learn through real-life problem solving. LCY has partnered with the City of Auburn for the 2016-2017 academic year, the inaugural year of the program.

The UW's Livable City Year program is led by faculty directors Branden Born with the Department of Urban Design and Planning, and Jennifer Otten with the School of Public Health, in collaboration with UW Sustainability, Urban@UW and the Association of Washington Cities, and with foundational support from the College of Built Environments and Undergraduate Academic Affairs. For more information contact the program at uwlcyc@uw.edu.



LIVABLE CITY YEAR: ONE YEAR. ONE CITY. DOZENS OF
UW FACULTY AND HUNDREDS OF STUDENTS, WORKING
TOGETHER TO CATALYZE LIVABILITY.

LCY.UW.EDU

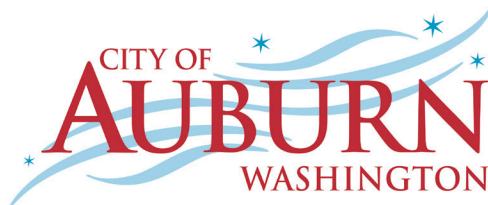
ABOUT THE CITY OF AUBURN

The City of Auburn is well-positioned to take advantage of many of the opportunities in the Puget Sound region. Centrally located between Seattle and Tacoma, Auburn is home to more than 77,000 residents. It is the land of two rivers (White & Green), home to two nations (Muckleshoot Indian Tribe & City of Auburn) and spread across two counties (King & Pierce).

Auburn was founded in 1891 and has retained an historic downtown while also welcoming new, modern development. Known for its family-friendly, small-town feel, Auburn was initially an agricultural community, the city saw growth due to its location on railroad lines and, more recently, became a manufacturing and distribution center. Auburn is situated near the major north-south and east-west regional transportation routes, with two railroads and close proximity to the Ports of Seattle and Tacoma.

Auburn has more than two dozen elementary, middle and high schools, and is also home to Green River College, which is known for its strong international education programs. The city is one hour away from Mt. Rainier, and has many outdoor recreational opportunities.

The mission of the City of Auburn is to preserve and enhance the quality of life for all citizens of Auburn, providing public safety, human services, infrastructure, recreation and cultural services, public information services, planning, and economic development.



WWW.AUBURNWA.GOV

01 EXECUTIVE SUMMARY

This project calculated current lunchtime trash, recycling, and compost rates in elementary, middle and high schools in Auburn School District, and evaluated current food waste patterns to determine if wasted food could be rescued and reallocated to feed students or community members experiencing food insecurity. Waste audits at 15 Auburn schools were performed. The following process was followed to calculate current and potential lunchtime recycling rates in each school: weighing and recording bags of trash, recyclable materials, and compostable materials received from lunchrooms and kitchens in order to determine the current pre-sort lunchtime rate; sorting each item from those bags into its correct receptacle; and weighing and recording the correctly sorted bags to determine the potential post-sort rate.

THIS PROJECT INDICATED THE EFFECTIVENESS OF FOOD WASTE PREVENTION EFFORTS AND SUGGESTED THE NEED FOR CONTINUATION OR IMPLEMENTATION OF A COMPOST SYSTEM, DEVELOPMENT OF STUDENT GREEN TEAMS AND/OR FACULTY/STAFF SUSTAINABILITY ADVOCATES, AND ADOPTION OF A FOOD RESCUE PROGRAM

Data from this project revealed significant differences in the pre- and post-sort waste weights of both compost and trash overall. Post-sort compost rates were significantly higher than pre-sort compost rates, while post-sort trash rates were significantly lower than pre-sort trash rates. Pre- and post-sort rates of recyclable materials were not significantly different. Similar results were found regarding kitchen waste. This suggests that implementation and training for adherence to a lunchroom and kitchen composting system would effectively reduce trash rates while simultaneously increasing the amount of compost generated.

Additionally, factors such as school participation in the King County Green Schools Program, use of a student-run Green Team, and presence of lunchroom monitors and sustainability advocates had effects on lunchroom waste sorting. Further, waste audit data revealed a large amount of rescuable food was being disposed in waste bins following lunch. This food may be diverted to students or community members suffering from food insecurity by means of a food rescue program, such as a lunchroom food share or a school-to-food-bank donation service. Overall, the results from this project indicated the effectiveness of food waste prevention efforts and suggested the need for continuation or implementation of a compost system, development of student Green Teams and/or faculty/staff sustainability advocates, and adoption of a food rescue program.

02 INTRODUCTION

Food waste occurs at every point within the food system, from production at the farm to transporting and selling goods to consumers, ultimately resulting in approximately 40% of produced food going uneaten (Gunders 2012). The growing issue of food waste affects both human and environmental health. The U.S. Department of Agriculture (USDA) estimates that if edible food waste could be reduced by 15% and re-distributed to food insecure individuals nationwide, that an additional 25 million people could be fed each year (USDA Economic Research Service 2016). Edible food that is wasted also represents squandered labor, energy, water, and land resources. The National Resources Defense Council estimates that we waste 10% of energy, 80% of total used U.S. freshwater, and 50% of U.S. land annually via the food we waste (Gunders 2012). In addition, diverting food from landfills to other more preferred uses, such as feeding animals or composting, could lessen the environmental impact of landfill-generated carbon emissions from food waste, which comprises 17% of landfill mass (Hickey and Ozbay 2014). Food waste reduction efforts have been developing worldwide at individual, institutional, and governmental levels to effectively reduce its impacts on human and environmental health. To guide these efforts, the Environmental Protection Agency (EPA) has created a hierarchy of methods for preventing and diverting wasted food in the order in which they most benefit the environment, society, and the economy (EPA 2017). The most preferred methods include reducing the problem at the source and donating extra food to feed hungry people. The EPA then recommends that extra food be donated to feed animals, applied to industrial uses, or composted. Finally, the least preferred method of disposal is to send extra food to the landfill.

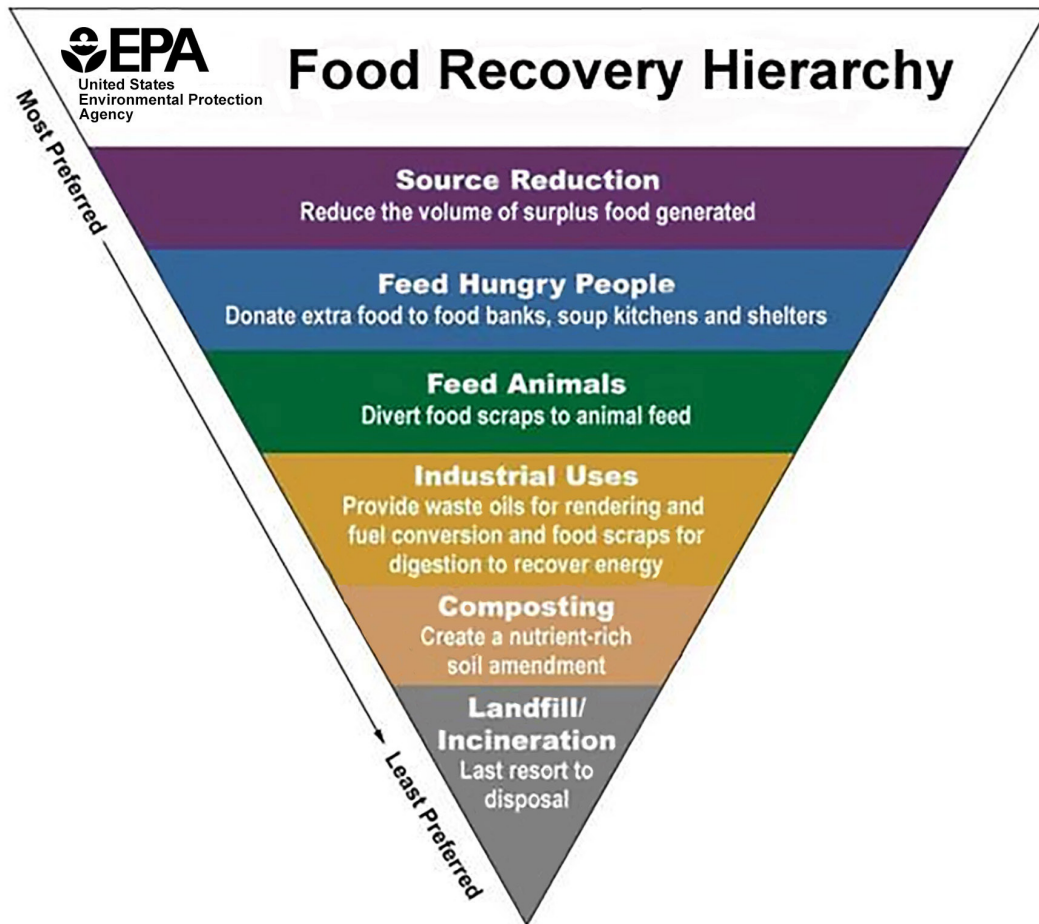


FIGURE 1

EPA Food Recovery Hierarchy for diverting food waste.

Credit: Environmental Protection Agency

Food Waste Reduction and Recovery Efforts in Schools

School cafeterias across the country generate a significant amount of waste, including food waste. An estimated 30 to 50% of edible food in schools is not eaten by students and is instead sent to landfills or composting facilities (CalRecycle 2016). In response, many U.S. schools have made commitments to educating students about the amounts and types of food they waste and encouraging them to reduce waste by engaging in prevention and recovery goals.

In King County, Washington, the King County Green Schools Program aims to provide schools with the ability to “initiate and expand waste reduction and recycling practices and other conservation actions, involve the whole school community in environmental stewardship, [and] operate environmentally efficient and responsible facilities” (King County 2016). This four-level program encourages schools to adopt practices in waste reduction and recycling (Level 1), energy conservation (Level 2), and water conservation and pollution prevention (Level 3). Schools in Level 4 aim to sustain their best practices in Levels 1 through 3 and continue striving for a more sustainable school system. Some of the activities suggested by the Green Schools Program aimed specifically at food waste reduction include collection of compostable materials, signage for waste bins, formation of a faculty and student-led Green Team, educating students and staff about waste

prevention strategies including what materials can be recycled and composted, and adoption of a food rescue program by means of a food share table or food donation (King County 2016). In addition, participation in Green Schools Programs can be economically attractive to schools. For example, Tahoma School District of Maple Valley, WA reduced its trash disposal costs by 24%, saving \$25,000 total between the 2007-2008 and 2009-2010 school years as a result of participation in King County Green Schools Program (King County 2013). Additionally, Camelot Elementary School of Federal Way, WA reduced trash collection costs by 25% after implementation of collection of compostable materials and reducing the size of the outdoor trash dumpster (King County 2016).

The concept of “food share” tables is also being adopted in some schools. Food share tables are locations where students can donate unwanted but edible food to their hungry or food insecure classmates or to food recovery organizations in their communities. Within King County, acceptable food share food items are unopened, packaged foods and drinks and whole, uneaten fruits from the school lunch program, but excludes food items brought from students’ homes. King County reports that food insecurity affects 16% of the population of the City of Auburn, which is higher than both the national average of 13% and King County average of 12% (King County Public Health 2013). Additionally, more than half of students in the Auburn School District are eligible for federally-subsidized free or reduced-price lunch. Thus, edible, uneaten food from Auburn School District schools has the potential to be shared with hungry students and community members through school food share systems and via donation to organizations like the Auburn Food Bank, which serves approximately 140 families daily (Auburn Food Bank 2017).

THIS PROGRAM ENCOURAGES STUDENTS TO
DONATE THEIR UNOPENED, PACKAGED FOODS
AND BEVERAGES AND WHOLE FRUITS TO OTHER
STUDENTS WHO MAY STILL BE HUNGRY

To aid in these types of food recovery efforts, the USDA has recommended ways individual schools can implement these food rescue programs. The Bill Emerson Good Samaritan Food Donation Act of 1996 exempts institutions and organizations that donate food in good faith from any liability for food-related illness and injury from the donated foods (Bill Emerson Act 1996). This law, in addition to several USDA referendums, have encouraged food donations from schools as well as other food-service institutions. A 2016 USDA referendum provided guidelines for the operation of food share tables within schools to encourage this programming and reduce school food waste. Following this USDA memo, the States of Connecticut and North Carolina released their own guidelines for implementing share tables throughout their state school systems (Melia 2017, Connecticut Department of Education 2017). Both state-specific guidelines are stricter than the federal guidelines, but provide examples of food share program implementation in large school districts. North Carolina representatives claim that their share tables have the capacity to collect thousands of food items to share amongst classmates (Terry 2017).

Scope of the Project

The King County Green Schools Program has partnered with EPA Region 10 to create a pilot School Food Share Program. This program encourages students to donate their unopened, packaged foods and beverages and whole fruits to other students who may still be hungry following their meal via a common share area. Additionally, this program aims to divert food and drink items to local food banks and community members if enough food items are collected to justify the costs associated with storage and transport of donations. Auburn schools are likely generating enough wasted food that it can be diverted away from landfills to one of these food rescue programs. However, little is known about current practices for rescuing food or the actual quantities or types of edible food being wasted in the Auburn School District. In addition, this project's stakeholders did not know the exact potential for each school to improve trash, recycling, and compost rates. Thus, this project aims to conduct a comprehensive analysis of cafeteria and kitchen solid waste practices in Auburn schools to help the Auburn School District, as well as King County, better understand current food waste and recovery practices and to identify strategies for reducing and diverting waste for the benefit of schools, the surrounding community, and the environment.



FIGURE 2

Food share area containing uneaten food following a lunch period.

Credit: Student Team

To achieve this aim, University of Washington (UW) students, in collaboration with the City of Auburn Solid Waste Division, the Auburn School District, and King County Green Schools Program, were rigorously trained to quantify the amount of food waste generated at individual Auburn schools by grade levels (i.e., elementary, middle, and high school) using food waste audits and to observe and document current food waste practices and food share efforts. Data were gathered from January through March 2017, on what percentage of lunchroom and kitchen waste

is comprised of garbage, recyclable materials, and compostable materials, as well as what percentage and types of edible food could be reduced or recovered.

In addition, UW students collected observational data on what strategies are used to direct students to sort their waste or divert edible food (e.g., labeling on waste bins, description and visibility of food share areas). These findings were then analyzed to provide insights into the feasibility of adopting a permanent food rescue program across the school district, either as a food share system within the school or as a school-to-food-bank donation service. Project findings were also analyzed to compare and contrast efforts between schools, such as implementation of current food rescue programs, lunchroom-focused sustainability efforts, and the effectiveness of these programs on lunchroom waste sorting.

03 METHODS

Sample and Approach

Four teams of undergraduate students completed food waste audits at 15 of 22 schools in the Auburn School District: two high schools (50% of all Auburn high schools), two middle schools (50% of all Auburn middle schools), and 11 elementary schools (80% of all Auburn elementary schools). Representatives from the City of Auburn, Auburn School District, and King County Green Schools Program collaborated with student teams to inform and obtain approval from Auburn schools' faculty and staff for this project. Each Auburn school provided a primary contact, typically the school's head custodian, as well as a designated work site for UW student teams. Upon arrival at each school, student teams checked in at the front office to verify their permission to work at the school and were led to their work site by the head custodian.

King County Green Schools Program representatives provided an orientation and one on-site food waste audit training to ensure consistency in auditing across the teams. After the on-site food waste audit training, all remaining audits were performed independently by UW student teams. During on-site audits, representatives from King County Green Schools and Auburn School District provided assistance and supervision in-person and by text message, with sporadic in-person check-ins at the individual schools.



Credit: King County Solid Waste

Orientation and on-site training involved teaching UW students relevant King County Green Schools Program recommendations for practices, including which items or parts of items belonged in trash, recycling, and compost bins, as is described in Figure 3. These recommendations are based on what materials are accepted at the major trash, recycling, and composting processing facilities where school-generated waste was destined. Additionally, training clarified sorting practices for items that are commonly sorted improperly, such as bottle caps and foil yogurt container wrappers.

FIGURE 3
King County Solid Waste guidelines for sorting trash, recycling, and compost.

Food Waste Related and Sustainability Practices

Online research and conversations with Auburn School District representatives provided information regarding each school's population size, percentage of students utilizing free and reduced school lunches, and Green Schools Program levels. This information was then used to better contextualize each schools' current practices, sustainability initiatives, waste practices, and food sharing program.

FIGURE 4

Trash, recycling, and compost waste bins with visible, obvious signs indicating which items belong in which bin.



Credit: Student Team

UW student teams recorded observations of lunchroom and kitchen layout, lunch line layout and serving style, accessibility and ease of use of waste containers, and each individual school's emphasis and programming regarding food waste and sustainability. Either prior to or during lunch periods, teams collected information regarding the following items within the lunchroom:

- If trash, recycling, and compost containers were placed next to each other
- If waste bins were color coded
- If there were signs or labels indicating what belongs in each bin
- If recycling containers were lined with clear plastic bags
- If there was a container for students to dump leftover liquids
- If there were monitors helping students sort waste properly

In addition, when possible, UW student teams found information about the following: the service policy in use for all menu items; the presence of a school garden; and nutrition education programs and/or cooking classes available for students. Further observations could include conversations with school Green Team members and/or sustainability advocates, including teachers, custodians, or lunchroom monitors. These conversations often provided further insight into current school efforts to foster environmentally sustainable practices.

Waste Sorts

Waste audits were performed using “trash-on-a-tarp” methodology, whereby UW student teams sorted through lunchroom and kitchen waste to determine individual school sorting rates. For middle and high school students, each school’s head custodian would deliver waste bins to student audit teams after each lunch period, and the teams would record waste weight according to each lunch period. For elementary schools where students eat in classrooms, custodians delivered waste bins as individual classes were finished eating, and total waste weight was recorded as a single lunch period.

Audits were systematically completed by weighing, photographing waste, and then correctly sorting and then re-weighing waste items per the school’s waste hauler classifications for trash, recycling, or compost. Upon receiving waste, student teams recorded each bag’s original designation and immediately recorded the pre-sort weights for trash, recycling, or compost. Students photographed the bags to capture observational data in terms of size and content of each individual bag. Each bag was then correctly re-sorted by hand by the student teams. The teams did this by leaving all compostable items in the current bag regardless of their original designation and removing items considered to be recycle or trash and placing them into new correctly-sorted bags. Following the sort, each of the three bags’ post-sort weight was recorded to determine the accurate trash, recycling, and compost weights. This process was completed with each trash, recycling, and compost bag that was filled during a lunch period.

FIGURE 5

(clockwise from the upper right) A: Students prepare the tarp in a clean, open space prior to receiving any waste.; B: Garbage bags from lunchroom bins, prior to UW student teams sorting.; C: UW students separate every piece of waste per its classification as trash, recycling, or compost.; D: Rescuable food items found following sorting of all trash, recycling, and compost bags.



Credit: Student Team

In addition, any rescuable food found in waste bags during sorting was set aside to be recorded separately. These items included certain whole fruits, such as apples, bananas, oranges and fruits with intact peels; other items included single serving sealed baby carrot packages, fully sealed milk and other beverage containers, sealed applesauce or yogurt containers, and other single serving factory-sealed food items such as granola bars. Counts of rescuable food items were recorded after all waste bags were properly sorted.

The same sorting procedure was followed with any kitchen waste, except for cardboard. As cardboard is typically separated from other kitchen trash, recycling, and compost, UW student teams did not include cardboard in the total recycling by weight. Observational notes were taken when cardboard was properly sorted in separate bins. Rescuable food was also recorded when identified in kitchen waste.

Full, unwrapped, and uneaten entrées found in lunchroom and kitchen waste bins were not considered rescuable due to food safety liability. In addition, it was difficult to determine if full, unwrapped, and uneaten entrées in kitchen waste bins were rescuable because it was not known if these entrées had expired, or were leftovers from the serving line where students received meals or from hotboxes in the kitchen's back-of-house that never reached the serving line. Additionally, measuring full entrées is not part of the trash-on-a-tarp protocol followed in this project. For these items, the student teams recorded notable observations if they saw full lunch entrées in waste bins.

Food Share Observations

In addition, the presence, capacity, and usage of food share programs or areas was noted. Food share areas are defined as locations where edible and rescuable foods are preserved for consumption by other students or donation. Lunchroom observations included finding this area, noting its surroundings, any signage defining the area, and if it was used during any or all lunch periods. All food share items were potential rescuable foods, and could be tallied as such following the final lunch period.

Analysis

It was hypothesized that schools currently collecting compostable materials were likely adhering to waste sorting standards better than schools without composting systems. It was also hypothesized that schools participating in the King County Green Schools Program at any level were also likely adhering to waste sorting standards better than those not participating in the program at all.

Data on current food waste and sustainability practices were compiled and reported in summary. The data collected from each waste audit were entered and

analyzed in Microsoft Excel to describe each school's current and potential waste, recycling, and compost rates and to describe the types and quantities of edible but wasted food.

Pre-sort weights of compostable materials, recyclable materials, and trash were used to calculate current compost, recycling, and trash rates. This report defines trash rates as the weight of items designated as trash compared to the total weight of items in all waste bins; recycling rates represent the weight of recyclable items compared to the total weight of all waste; compost rates represent the weight of food and non-food compostable items compared to the weight of all waste.

Potential rates were calculated based on post-sort weights compared to the total waste weight. Statistical analyses were performed using R statistical software to run t-test analyses. A t-test is a statistical test that utilizes the mean of two different samples that are representative of larger populations. The difference of these two means is used to determine the statistical significance of the two data samples. Paired t-tests are used when two sample sets contain complementary data. Paired t-tests were used to examine differences between current and potential rates for compost, recycling, and trash. These data were further analyzed to examine for differences between current and potential recycling and compost rates in schools with and without composting systems. In addition, these rates were further compared by grouping schools with and without the following: Greens Schools Program level, presence of a student Green Team, and presence of a staff/faculty lunchroom waste monitor. Lastly, rates between elementary versus middle and high schools were compared to determine if there were differences in sorting rates at different grade levels.

Food share data were analyzed according to counts obtained at each individual audit. These numbers were summed to determine total number of rescuable food overall, as well as by each individual type of food (e.g. total number of apples, total number of unopened chocolate and white milk containers). Calorie content of each food item was assessed as well and summed to determine the total number of rescuable calories.

04 RESULTS

Characteristics of Schools

Relevant information for the audited schools is represented in Figure 6, including each school's percentage of children eligible for free and reduced-price school lunch. According to the Office of the Superintendent of Public Instruction, the Auburn School District serves free or reduced-price meals to 53% of all students at all grade levels (Office of Superintendent of Public Instruction 2016). Figure 6 shows how this breaks down at each of the schools represented in this project, ranging from 21% to 85% of students. Eligibility for the USDA's free and reduced-price lunch program is determined by household income, where households at or below 130% of the federal poverty level qualify for free meals and those at or below 185% of the federal poverty level, but above 130%, qualify for reduced-price meals (USDA 2016). These data illustrate that more than half of Auburn School District's students are from families at or below 185% of the 2016 federal poverty level, indicating significant potential benefit for food share and/or food donation programs associated with the schools. This is particularly important at the four schools where more than three-quarters of students are receiving free or reduced-price lunch, as well as the school with the highest free or reduced-price lunch participation and no current food share program.

Food Waste Related and Sustainability Practices

Figure 6 also describes each school's level of participation in the King County Green Schools Program. Level 1 Green Schools focus on waste reduction and recycling with an aim to divert 40% or more of the school's overall waste from trash to any form of recycling, including composting (King County 2016). Level 2 schools focus on energy conservation, while maintaining Level 1 practices, and Level 3 schools focus on water conservation and pollution prevention, while maintaining Level 2 and 3 practices. Both Level 2 and Level 3 include additional waste reduction and recycling criteria. Five schools are not currently participating at any level and 10 schools are participating in at least Level 1 (n=5 at Level 1; n=3 at Level 2; n=2 at Level 3). This variation allows for both observational and statistical comparison of outcomes based on the expectation that the schools participating in Level 1 or greater would have better overall sorting rates and less contamination in all waste bins.

Nutrition- and sustainability-focused practices observed in the schools are also summarized in Figure 6. The most pertinent findings to this project are as follows.

School	Grade Level	Size of Student Population	Students Who Receive Free/Reduced Lunch (%)	Green Schools Program Level	Active Green Team at Time of Audit	Monitors Present to Help Students Sort	School Garden Present	Nutrition and/or Cooking Class Offered
A	E	603	57.4	0	N	Y	N/A	N/A
B	E	628	46.5	2	Y	Y	N ²	NUTR
C	E	476	68.7	1	N	Y	N	NUTR
D	E	539	75.3	0	N	Y ¹	N	NUTR
E	E	600	80.7	1	N	Y	N	N/A
F	E	557	46.0	1	N/A	N	N/A	N/A
G	E	593	55.1	2	Y	Y	N	N/A
H	E	687	21.3	3	Y	Y	N/A	N/A
I	E	430	62.3	3	Y	Y	Y	N/A
J	E	492	85.0	0	N/A	N	N	NUTR
K	E	494	76.5	2	Y	Y	N/A	N/A
L	M	964	48.7	1	N	N	N	BOTH
M	M	890	44.5	0	N	Y	N	BOTH
N	H	1440	36.2	1	N	N	Y	BOTH
O	H	1548	33.4	0	N	N	N/A	N/A

Credit: Schupp

FIGURE 6. CHARACTERISTIC DATA FOR ALL SCHOOLS AUDITED

Size of student population is based on data taken in May 2016. E = elementary school; M = middle school; H = high school; 0 = not currently participating in Green Schools Program; 1,2,3 = current Green Schools Program level; Y = yes; N = no; N/A = information not acquired at this school; NUTR = nutrition class offered; BOTH = both nutrition and cooking classes offered. Y¹ = No specific monitors were present; rather, some teachers helped aid students in sorting; N² = School garden is not currently present, but the school has had one in the past.

Two-thirds of the schools audited (10 out of 15) utilize lunchroom monitors to instruct students on proper sorting practices. However, only five schools had student Green Teams, where students serve as sustainability advocates and lunchroom waste monitors under the guidance of custodians and/or teachers. These students could share knowledge with their peers regarding proper sorting methodology in addition to promoting other sustainable practices. Notably, Green Teams were only present at elementary schools and only one of the four middle and high schools had an adult lunchroom monitor. Additionally, seven of the total 15 schools offered nutrition and/or cooking classes as electives for students, and two schools had school gardens. One of these gardens utilized regional compost for the garden's soil to educate students on the cycle of food waste becoming soil to grow new food with.

Lunchroom specific observations related to organization and feasibility of waste bins and related lunch waste areas are summarized in Figure 7. All 15 schools had color-coded waste bins lined with clear plastic bags placed next to each other to promote easier sorting. Two elementary schools were observed to have a well-established sorting protocol implemented into the school's lunch routine. Specifically, these schools had tables and waste bins arranged for students to first remove silverware, then to dump leftover liquids, then to sort recycling, garbage, and compost, and finally to stack lunch trays on the last table. Some schools lacked basic sorting instruction, such as signage indicating which items belong in which waste bins. Most schools that did have signage at every bin and at every station did

	School															
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	
	Grade Level															
	E	E	E	E	E	E	E	E	E	E	E	M	M	H	H	
Lunchroom Characteristic																
Waste Bins Placed Next to Each Other	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Waste Bins are Color Coded	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Signs/Labels Indicate Contents of Each Bin	Y ¹	Y ¹	Y ¹	Y ¹	Y ¹	Y	N	Y	Y	N	Y	N	N	Y ¹	Y ¹	
Bins Use Clear Plastic Bags	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Lunchroom Has a Liquid Dump Container	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N ²	Y	Y	N	N	
Food Share Area Present	Y	Y	Y ³	Y ³	Y ³	Y	Y	Y	Y	N	Y	Y ³	Y ³	Y ³	N	

Credit: Schupp

FIGURE 7. LUNCHROOM CHARACTERISTICS TABLE

Lunchroom-specific observational data recorded during waste audits. Y = yes; N = no; Y¹ = Not all bins had visible labels and/or not all labels were 3-dimensional; N² = Rather than a liquid dump bin, this school had a lunchroom-wide “finish what you take” policy specific to milk; Y³ = These food share areas were in inconvenient and/or unattractive locations (i.e. next to waste bins).

not include three-dimensional signs to provide physical examples of which items belong in each bin. A photo in Figure 8 provides an example of a three-dimensional sign that was utilized at one elementary school; a few other elementary schools utilized similar signs as a sorting teaching aid. In addition, one school utilized signs in both English and Spanish.

Liquid waste bins aid in proper waste sorting and reduction of food waste. Providing students with the opportunity to dump their liquid waste reduces the potential contamination of recycling by non-recyclable items. For example, partially-finished milk or plastic beverage bottles must be emptied prior to disposal in a recycling bin. The presence of liquid waste bins provides students the opportunity to do this, thus encouraging proper sorting. Both high schools and one elementary school did not have liquid dump containers next to their waste bins, though all other schools did utilize liquid waste containers. These containers ranged from a simple bucket on a table to a repurposed unlined compost bin to a liquid-specific bin containing a sieve to catch any solids that may accidentally be dumped. The



FIGURE 8

(clockwise from the upper left) A: Three-dimensional signs provide examples of how each item should be sorted into trash, recycle, and compost.; B: Repurposed bucket used as liquid dump container on table in waste sorting area.; C: King County Green Schools poster displayed above waste sorting area at

one elementary school without a liquid waste bin implemented a policy whereby students are required to drink all their milk, as enforced by teachers and adult or student lunch waste monitors. Custodians and UW student audit teams report that this “finish what you take” policy did result in reduced liquid in trash, recycling, and compost bins.

All but two schools had a food share system in place that was easily observed. Six of the thirteen schools with food share areas had the food share in inconvenient locations, such as immediately next to waste bins and the liquid dump station or in a difficult to find area of the cafeteria. Siting food shares in such locations may deter students’ involvement. These six schools also did not have clear signage indicating the food share area’s purpose. Therefore, it is likely that some students did not know they could leave their unused but edible food items nor that they could obtain additional food that had been placed in the food share area.

Additionally, all schools utilize a serve, rather than offer, policy to some degree in the lunch line, where students are given foods rather than receiving offers for all foods. Although students are offered choices for many if not all items, each meal is required to meet criteria based on federal regulations prior to students exiting the lunch line.

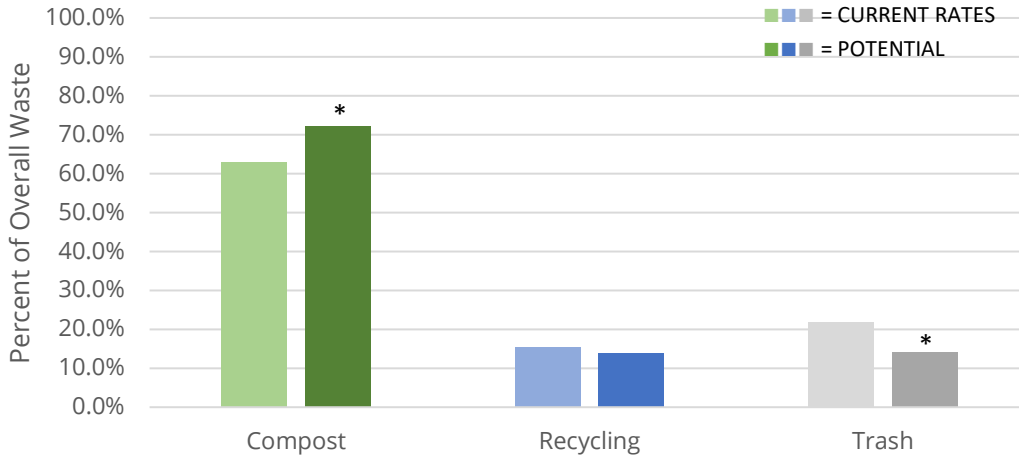
		Current Compost	Potential Compost	Difference After Sort	Current Recycling	Potential Recycling	Difference After Sort	Current Trash	Potential Trash	Difference After Sort
Elementary	A	45.9%	76.6%	30.8%	11.4%	9.9%	-1.5%	42.7%	13.5%	-29.2%
	B	70.2%	72.3%	2.1%	12.4%	10.6%	-1.8%	17.4%	17.1%	-0.3%
	C	71.9%	75.4%	3.5%	17.4%	13.0%	-4.4%	10.7%	11.7%	1.0%
	D	0.0%	69.1%	69.1%	11.4%	12.7%	1.3%	88.6%	18.2%	-70.4%
	E	60.9%	66.5%	5.6%	15.2%	11.7%	-3.4%	24.0%	21.8%	-2.2%
	F	0.0%	64.6%	64.6%	14.3%	16.0%	1.7%	85.7%	19.4%	-66.2%
	G	0.0%	67.4%	67.4%	9.3%	11.3%	2.0%	90.7%	21.3%	-69.4%
	H	68.7%	71.9%	3.2%	15.8%	18.0%	2.2%	15.6%	10.1%	-5.5%
	I	73.7%	74.0%	0.3%	12.0%	14.1%	2.1%	14.3%	12.6%	-1.7%
	J	0.0%	58.9%	58.9%	15.6%	16.4%	0.8%	84.4%	23.5%	-60.9%
	K	64.6%	71.6%	7.0%	21.1%	20.4%	-0.7%	14.2%	7.9%	-6.3%
Middle/High	L	0.0%	37.3%	37.3%	19.5%	11.1%	-8.3%	80.5%	51.6%	-29.0%
	M	0.0%	74.0%	74.0%	10.8%	12.9%	2.1%	89.2%	12.7%	-76.5%
	N	47.3%	69.6%	22.3%	17.1%	12.4%	-4.6%	35.6%	18.0%	-17.7%
	O	0.0%	47.8%	47.8%	11.4%	12.1%	0.7%	88.6%	40.1%	-48.5%
Average (N=8)		62.9%	72.2%	9.3% *	15.3%	13.8%	-1.5%	21.8%	14.1%	-7.7% *

Credit: Schupp

FIGURE 9. LUNCHROOM DATA

Current percentages are based on pre-sort rates, which represent how students are currently sorting waste. Potential numbers are based on post-sort rates, which represent the true rates if all waste had been properly sorted by Auburn students. Average rates exclude schools that do not compost in the lunchroom. Red = no compost system in place; Yellow = schools composting >25% of total waste; Green = schools composting >50% of overall waste. *p<0.05

AVERAGE COMPOST, RECYCLING, AND TRASH RATES IN LUNCHROOMS



Credit: Schupp

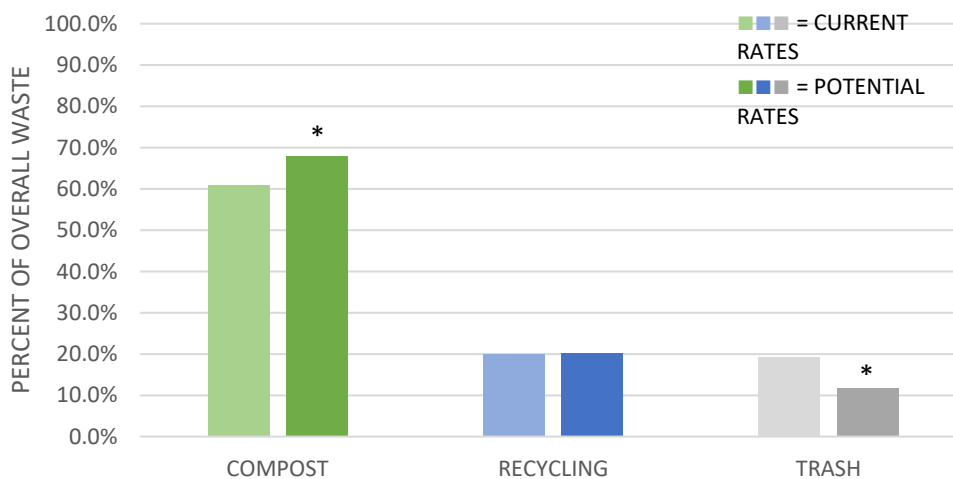
FIGURE 10

Of the lunchrooms that did provide compost bins (n=8), the mean current and potential compost, recycling, and trash rates are depicted. Statistical significance was found in the difference between current and potential compost and trash rates. *p<0.05

Waste Audit Data and Results from Statistical Analyses

Figure 9 shows current and potential trash, recycling, and compost rates as well as the difference between these rates for the schools' lunchrooms. Seven of the 15 schools (four elementary and three middle/high schools) did not have lunchroom compost systems in place, and were excluded from further analysis. Figure 10 depicts the results from paired t-tests of the eight schools that currently compost. The mean potential, post-sort lunchroom composting rate was significantly greater than the mean pre-sort rate. Additionally, the mean post-sort trash rate was significantly less than the mean pre-sort trash rate. No statistically significant difference was found with pre- and post-sort recycling rates.

AVERAGE COMPOST, RECYCLING, AND TRASH RATES IN KITCHEN



Credit: Schupp

FIGURE 11

Of the kitchens that did utilize compost bins (n=12), the mean current and potential compost, recycling, and trash rates are depicted. Statistical significance was found in the difference between current and potential compost and trash rates. *p<0.05

		Current Compost	Potential Compost	Difference After Sort	Current Recycling	Potential Recycling	Difference After Sort	Current Trash	Potential Trash	Difference After Sort
Elementary	A	79.6%	85.8%	6.2%	0.0%	0.4%	0.4%	20.4%	13.8%	-6.6%
	B	93.5%	94.0%	0.5%	3.0%	3.5%	0.5%	3.5%	2.5%	-1.0%
	C	73.0%	78.1%	5.1%	16.1%	17.0%	0.8%	10.8%	4.9%	-5.9%
	D	41.7%	65.2%	23.5%	18.2%	26.2%	8.0%	40.1%	8.7%	-31.5%
	E	88.1%	91.0%	2.9%	0.0%	4.7%	4.7%	11.9%	4.2%	-7.6%
	F	67.0%	91.8%	24.9%	14.9%	0.4%	-14.5%	18.1%	7.8%	-10.3%
	G	33.5%	33.5%	0.0%	54.7%	54.7%	0.0%	11.8%	11.8%	0.0%
	H	58.8%	58.8%	0.0%	18.6%	18.6%	0.0%	22.6%	22.6%	0.0%
	I	35.6%	35.6%	0.0%	47.2%	47.2%	0.0%	17.2%	17.2%	0.0%
	J	30.1%	39.1%	9.0%	39.4%	39.8%	0.4%	30.5%	21.1%	-9.4%
	K	91.4%	90.6%	-0.7%	6.7%	6.7%	0.0%	1.9%	1.9%	0.0%
Middle/High	L	0.0%	51.9%	51.9%	0.0%	1.6%	1.6%	100.0%	46.5%	-53.5%
	M	0.0%	76.5%	76.5%	0.0%	0.0%	0.0%	100.0%	23.5%	-76.5%
	N	39.2%	50.3%	11.1%	19.9%	24.3%	4.4%	40.8%	25.3%	-15.5%
	O	0.0%	68.3%	68.3%	0.0%	2.4%	2.4%	100.0%	42.3%	-57.7%
		61.0%	67.8%	6.9% *	19.9%	20.3%	0.4%	19.1%	11.8%	-7.3% *

Credit: Schupp

FIGURE 12. KITCHEN DATA

Current percentages are based on pre-sort rates, which represent how students are currently sorting waste. Potential numbers are based on post-sort rates, which represent the true rates if all waste had been properly sorted by kitchen staff. Average rates exclude schools that do not compost in the kitchen. Red = no compost system in place; Yellow = schools composting >25% of total waste; Green = schools composting >50% of overall waste. *p<0.05

Figure 12 shows current and potential trash, recycling, and compost rates as well as the difference between these rates for the schools' kitchens. Three of the 15 schools (three middle/high schools) did not utilize compost systems in the kitchen and were excluded from further analysis. Similar results to the lunchroom data were found with kitchen waste. Figure 11 (previous page) depicts the results of the paired t-tests for the kitchen waste rates. The mean post-sort composting rate was significantly greater than the mean pre-sort rate, while the mean post-sort trash rate was significantly lower than mean pre-sort rate. Again, no significant difference was found with recycling rates pre- and post-sort.

Figure 13 represents the difference in trash rates separated by schools that do or do not compost in the lunchrooms. The eight schools that do compost decreased from a pre-sort mean of 21.8% of the overall waste as trash to a post-sort mean of 14.1% as trash, while the seven schools that do not compost decreased from a pre-sort mean of 86.8% to 26.7% of overall waste as trash. Both post-sort rates were significantly lower following the waste sort, regardless of the school's use of compost bins.

The 15 schools represent varying levels within the King County Green Schools Program. One elementary school that is not currently participating in the Green Schools Program is composting more than 25% of lunchroom waste, while the other

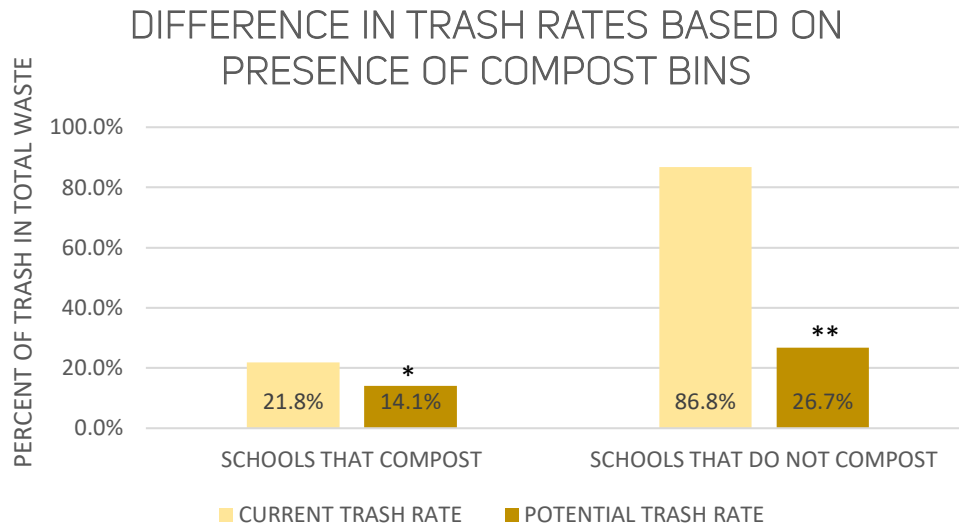


FIGURE 13

Comparison of schools that do and do not have compost bins in the lunchrooms. All schools had significantly lower potential trash rates compared to current trash rates, whether they currently compost or not. * $p < 0.05$ ** $p < 0.001$

Credit: Schupp

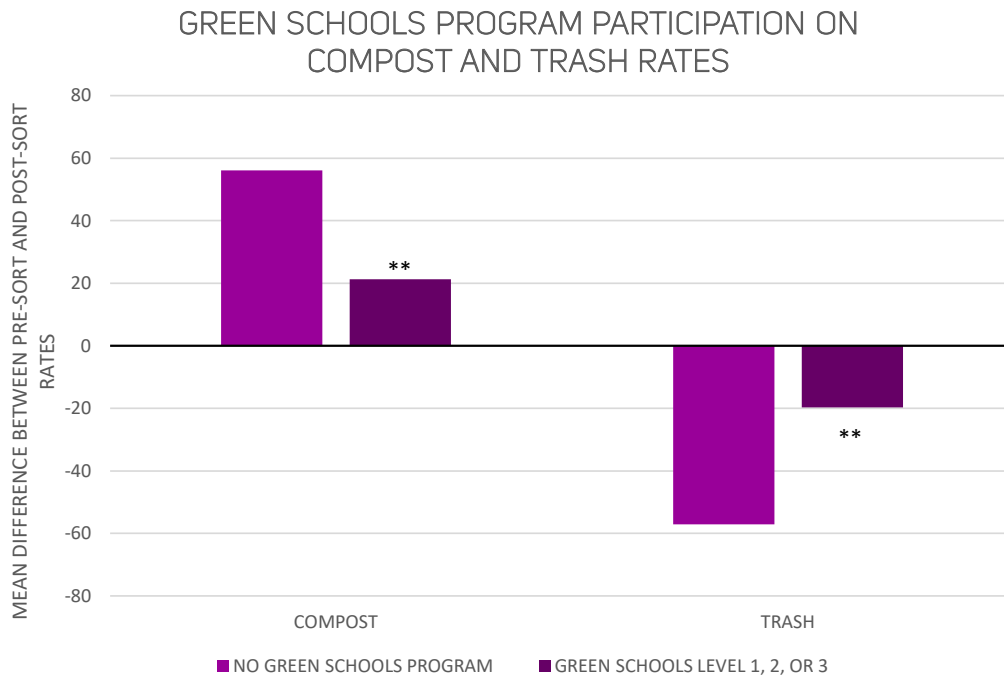


FIGURE 14

Comparison of schools participating (n=10) or not participating (n=5) in King County Green Schools program according to differences in pre-sort and post-sort compost and trash rates. ** $p < 0.01$

Credit: Schupp

four schools not participating are also not currently composting in lunchrooms. Additionally, three of the 10 schools at Level 1 or above are not composting in lunchrooms. Figure 14 shows the results of unpaired t-tests. The mean difference from pre-sort to post-sort compost rates, representing the amount of unrealized compost in other waste bins, is significantly greater in schools not participating in the Green Schools Program than those participating at any level of the program. The mean difference between pre-sort and post-sort trash rates, representing the unrealized portion of trash that was improperly sorted, is also significantly greater in schools not participating in the Green Schools Program. This means that Green Schools of any level are currently sorting compost and trash at rates closer to the potential rates calculated after the waste audits. The mean differences between pre-sort and post-sort compost and trash rates do significantly decrease with progression from non-participating schools to Level 3 schools. While each level

adopts new focuses and goals, previous ones like waste sorting are consistently maintained.

Beyond participation in the King County Green Schools Program, schools with a student Green Team did not have statistically significant differences between any mean current and potential rates, as compared with schools without a Green Team. The presence of lunchroom monitors or other faculty or staff sustainability advocates also did not result in statistically different mean current and potential waste rates, as compared to schools without monitors and/or sustainability advocates. Observations during waste audits found Green Teams, monitors, and sustainability advocates to be more highly involved in lunchroom waste sorting to promote better sorting and adherence to the Green Schools Program recommendations. Although the analytical data does not support the observational data, the anecdotal evidence from both UW student teams and Auburn faculty and staff promote the use of these sustainability advocates.

Based on observational data, elementary schools overall appeared to sort waste better than both middle and high schools, with high schools seeming to have the worst overall rates of correct sorting. Many ideas were discussed as to why this phenomenon was observed, but this study did not aim to understand why elementary schools were more likely to adopt sustainability-focused practices than middle or high schools. However, unpaired t-tests show that there was no significant difference in sorting rates between elementary schools and combined

		ELEMENTARY SCHOOLS											MIDDLE/HIGH SCHOOLS			
FOOD ITEM	TOTAL	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
WHOLE APPLE	151		2		1	1	17		1		2		1	55	51	20
CHOCOLATE MILK	102	10			5	30	4	15		2		2	16		14	4
MISCELLANEOUS PACKAGED FOODS	102	1	6	3	5	2	16	20	2	3	7	0	3	10	23	1
BABY CARROT BAG	73		9		25			3	1				23	12		
YOGURT	62		18		14	4	2	9		4	4			1	1	5
WHITE MILK	53	2	2		3	18	4	10		2			8	2	2	
WHOLE BANANA	52			1	19	4		1			1		11	12	2	1
FRUIT CUP	33		1					22			1	2	1	6		
JUICE BOX	24	1	2		1			11	1	1		1	4	1	1	
APPLESAUCE	25		5				9						11			
STRING CHEESE	23		18	1				1					2	1		
WHOLE ORANGE	20						1	1						1	8	9
WATER BOTTLE	1								1							
WHOLE ENTRÉE	6				3		1				1					1
TOTAL	727	14	63	5	76	59	54	93	6	12	16	5	80	101	102	41

Credit: Schupp

FIGURE 15

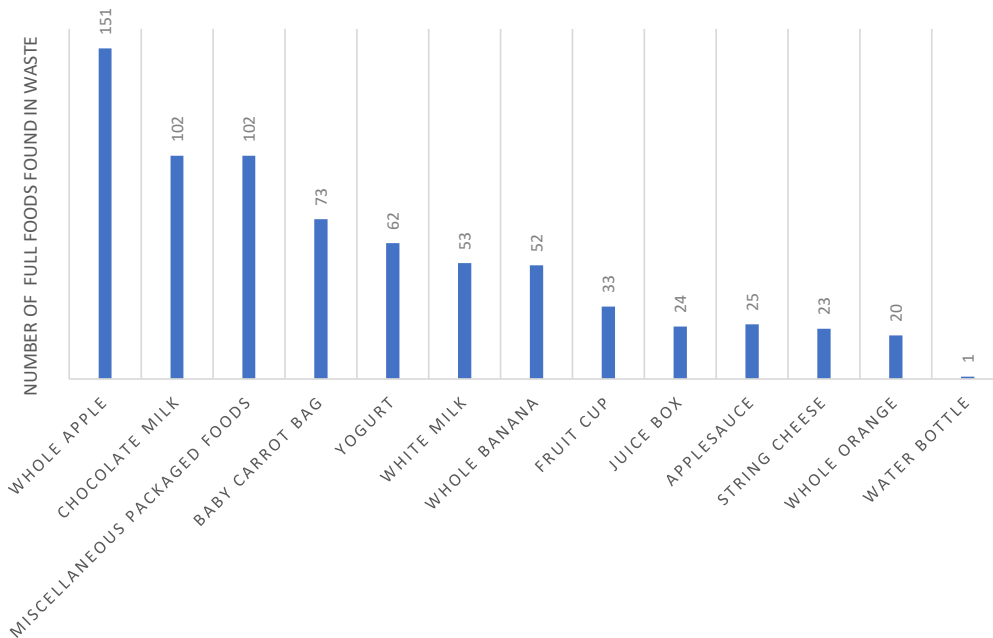
Distribution of rescuable food found during waste sort, separated by elementary and middle/high schools.

middle/high schools. This lack of significance may be due to the limited sample sizes, as only four middle and high schools were audited compared to eleven elementary schools.

Food Recovery and Food Share

Food share areas were utilized in most schools, but rescuable food items were still found in waste bins during audits at every school. Over the fifteen audit sites and days, UW student teams found a total of 727 rescuable food items which represented 85,356 calories. Calorie amounts for each individual item recorded were retrieved from the USDA National Nutrient Database (USDA 2016). Figure 15 shows the waste counts by food item at each individual school. These 727 items are broken down according to Figures 16 and 17, where Figure 17 represents the further breakdown of the 102 “miscellaneous packaged foods,” which were primarily packaged snacks that were collected as a result of the waste audits. Figure 18 (nxt page) represents the breakdown of the 85,356 calories wasted from the rescuable food items, taking into account each item from Figure 16 as well as each individual packaged items’ calorie count.

RESCUABLE FOODS FOUND IN WASTE BINS AT ALL SCHOOLS



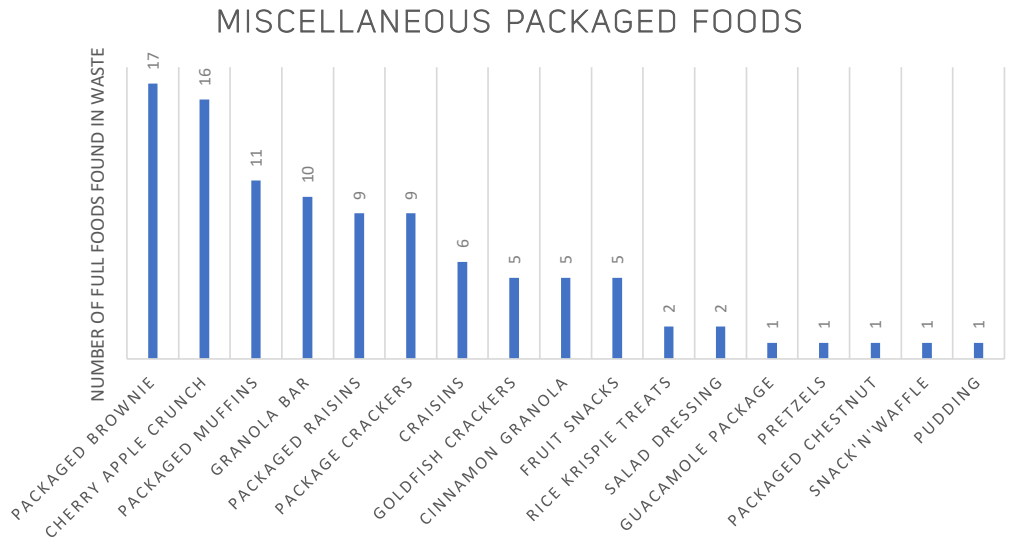
Credit: Schupp

FIGURE 16

Breakdown of full food items found in trash, recycling, and compost bags during waste audits. All items set aside were under rescuable standards according to King County Green Schools Program guidelines. Miscellaneous packaged foods are described in Figure 17.

FIGURE 17

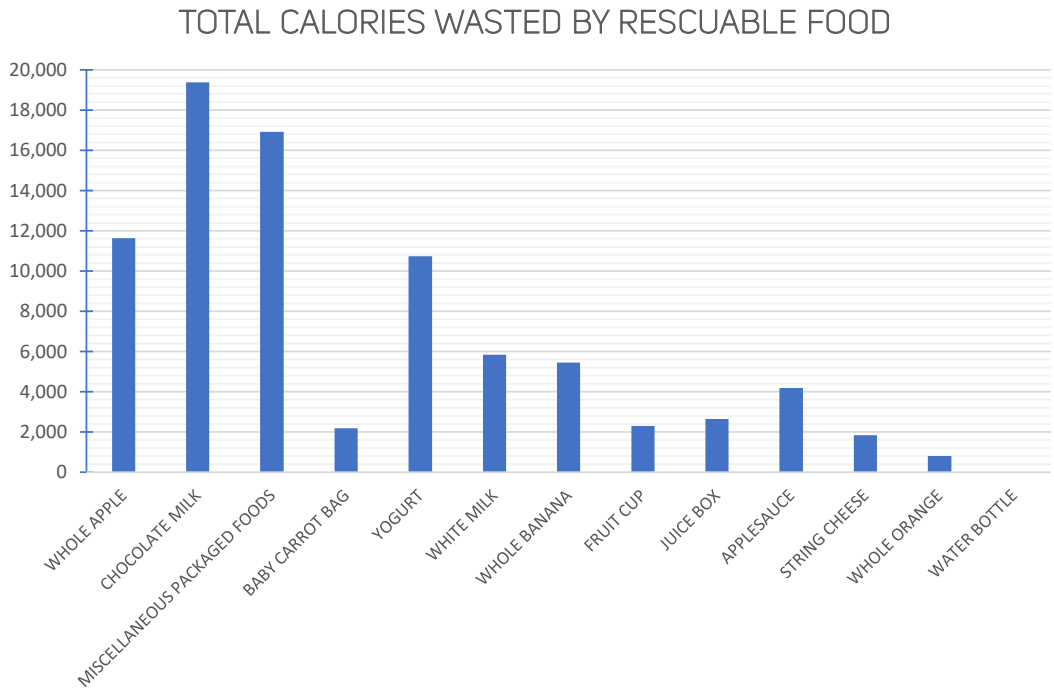
Breakdown of the 102 “miscellaneous packaged items” from Figure 15. All packaged items found in waste bags were completely sealed.



Credit: Schupp

FIGURE 18

Estimated total calories wasted from rescuable food items. Calorie amounts were determined according to the USDA National Nutrient Database.



Credit: Schupp

05 INTERPRETATION OF RESULTS

This evaluation illustrates that schools of all grade levels in Auburn are actively participating in a variety of sustainability practices. Specifically, most schools utilized lunchroom monitors to ensure students were sorting their lunch waste properly and most elementary schools utilized student-led Green Teams. These observations were expected to be indicative of better sorting rates due to a greater focus on sustainability at elementary schools, but no significant differences in correct sorting were found between schools with or without Green Teams or with lunchroom monitors or between elementary schools and combined results of middle and high schools. This lack of significance could be due to the small sample size by grade level (four middle/high schools versus 11 elementary schools), but also provides room for other possible explanations, such as if a focus on sustainability is carried forward as students transition from elementary through high school.

Further, the presence of sustainability “champions” appeared to have a strong impact on the students’ sorting ability in the lunchrooms based on UW students’ observations, but analytical data did not reveal a significant difference in schools that had these leaders versus those that did not. These champions were either teachers, custodians, or a combination of staff and faculty that highly valued sustainable practices within their schools and made extra efforts to promote these among students. As these individuals appeared to have a major impact on their schools, further analysis with a larger sample size should be performed to further test these findings. This may be done by sampling more schools and/or performing waste audits on additional days at the same schools.

Trash-on-a-tarp waste audit data found that all schools, regardless of presence of lunchroom compost bins, had significantly greater post-sort compost rates and significantly lower post-sort trash rates but no significant difference in pre- to post-sort recycling rates. These results indicate that the schools in this project are currently doing a good job sorting recyclable materials, but much of the trash currently generated in school lunchrooms and kitchens can be diverted to compost if all schools implement and adhere to a schoolwide compost system. This is further reflected in the high difference in trash disposal rates between schools that do have compost bins (8% decrease) versus those that do not (60% decrease). While both groups of schools have the potential to significantly reduce their trash rates, schools without compost bins could potentially reduce their trash waste by more than two-thirds, indicating a strong need for lunchroom compost bins in schools not currently utilizing them. Interestingly, this also suggests that students can sort recyclable items accurately and that perhaps programming and best practices that helped achieve these near-perfect recycling rates could be applied to the development of better food waste programming and practices. Notably, schools that participated in the Green Schools Program were more likely to sort compost and trash at rates closer to potential rates and elementary schools were more likely to participate in the King County Green Schools Program. Participation in King County Green Schools at Level 1 effectively improves both the compost and trash rates of participating elementary schools, and participation by middle and high schools may aid in achieving compost and trash rates similar to current elementary Green Schools.

IF THE FOOD RESCUE NUMBERS ARE REPRESENTATIVE OF THE SCHOOLS' DAILY RESCUABLE FOOD WASTE, OVER 1,000 APPLES ALONE COULD BE RESCUED WEEKLY FROM THE 15 AUDITED SCHOOLS TO FEED BOTH FOOD INSECURE STUDENTS AND THEIR FAMILIES

In terms of rescuable foods, national data reveal that fresh, unprocessed foods are often the most frequently wasted but also more rescuable foods (Amin 2015). Our project results were consistent with that finding. Whole apples were the top rescuable item found during waste audits, with baby carrot bags and whole bananas also commonly found. At the same time, this project also revealed that students across 15 Auburn School District schools wasted 102 full, sealed chocolate milks, second only to the 151 full apples thrown away. This finding was unexpected, as prior anecdotal knowledge implied that students prefer chocolate milk as their drink of choice at lunch time. However, 10 of the 15 schools wasted some amount of chocolate milk, with additional partially consumed cartons also found throughout trash, recycle, and compost bins. These findings, taken together, are intriguing for many reasons. Prior research has suggested that the new federal National School Lunch Program (NSLP) regulations for incorporating more healthful foods, such as the requirement to take one serving of fruit and one serving of vegetable, have resulted in increased waste of healthful food items (NSLP 2016). However, the findings from this project suggest that students are wasting both more healthful

and less healthful foods. In addition, these findings imply that additional beverage options, such as water, may be acceptable if offered in place of milk to both promote consumption and reduce waste due to unconsumed milk. Other studies have found that NSLP guidelines have improved the fruit and vegetable intake of middle schoolers and that schools utilizing “Smarter Lunchroom” principles to promote fruit consumption had improved consumption and lowered plate waste (Cohen et al. 2013, Greene et al. 2017). Lunchroom studies have also shown that increased time, increased choice, and smaller portion sizes may contribute to increased consumption and lowered food waste from elementary and middle schoolers (Adams et al. 2016, Byker et al. 2014, Cohen et al. 2016). This suggests that a combination of strategies might be more useful in reducing waste and promoting healthy food consumption. As the majority of wasted apples, 127 of the 151, in this evaluation were found at middle/high schools, these altered lunch policies may be needed especially at middle and high schools in order to reduce the total waste, particularly of full, rescuable food items like apples.

If the food rescue numbers are representative of the schools’ daily rescuable food waste, over 1,000 apples alone could be rescued weekly from the 15 audited schools to feed both food insecure students and their families in the Auburn School District or to donate to a local food bank. Beyond apples, other nutrient-dense items, such as other fruits, bagged baby carrots, and yogurt could be rescued to feed hungry individuals. Further expansion of an in-school food share network or a school-to-food-bank program should be explored to divert these wasted foods to human consumption.

Recommendations

Recommendations generated because of this project are in response to the findings above and a culmination of UW student teams’ observations in lunchrooms and kitchens, particularly focused on modeling the existing best practices of schools.

Student and Staff Support

Schools with student-led Green Teams and sustainability advocates saw better overall sorting rates, which may be attributable to the schools’ emphasis on sustainability. Schools with faculty/staff sustainability champions, in particular, could potentially use them as guest speakers in classes to train and encourage students to reduce food waste in the lunchroom. Further, when custodians monitored sorting, UW student teams observed less contamination, suggesting that any form of monitoring is beneficial in terms of students correctly sorting all lunchroom waste.

Lunchroom Organization

Recommendations regarding lunchroom organization are primarily derived from exemplary efforts at schools currently utilizing these strategies to reduce food waste. First, schools with all three types of waste bins (trash, recycling, compost)

placed as a set in multiple locations throughout a lunchroom may encourage correct sorting. For example, schools with trash bins placed near the exit of the lunchroom discouraged proper sorting when recycling and compost bins were located further away in isolated or inconvenient locations. Schools that had trash, recycling, and compost bins placed together at exits as well as throughout the lunchroom promoted the environment necessary for proper sorting.

Second, liquid dump containers allow for easier separation of heavy liquids from trash and compost to prevent plastic bag breaks and leakages. Currently, 12 of 15 schools audited have excess liquid dump containers. Liquid collections strategies may also prevent contamination of both recycling and compost so that these types of waste can be effectively processed at waste sorting facilities. Some schools also used a sieve to separate out solids from liquids being poured in the bin for easy waste removal of both solids and liquids.

SCHOOLS THAT HAD TRASH, RECYCLING, AND
COMPOST BINS PLACED TOGETHER AT EXITS AS WELL
AS THROUGHOUT THE LUNCHROOM PROMOTED THE
ENVIRONMENT NECESSARY FOR PROPER SORTING

Third, signage that clearly explains and encourages appropriate waste sorting allows for students to better understand best sorting practices. These signs appear to be most effective when they are at eye level for easy readability and to prevent damage from trash splash. Additional water-resistant signs stuck on bins can be helpful if signs above bins are removed or lost. Further, visually appealing, 3-dimensional signs provided useful visualizations explaining what items belong in which bin. Signage was especially important for non-traditional waste containers that were seen at various schools throughout the waste audits. While common bins such as green or yellow bins commonly signify composting, the use of uncommon containers can create confusion amongst students as to what a bin is designated for when there is no attending signage. There was a high variation in signage across Auburn schools which made it difficult to examine in any systematic way; it would be useful to determine which types of signs produced the greatest sorting rates. Examining the schools with the lowest difference between pre-sort and post-sort trash, recycling, and compost rates may provide examples of best practices for waste bin labelling.

Figure 19 (next page) represents one school's waste disposal area, whereby students were given instructions on the order in which to dispose of their items. This area included a stacking system for compostable trays, which both eliminates waste volume in bins and aids in waste sorting education. Schools that utilize reusable trays further eliminate waste and cost. The Minnesota Pollution Control Agency found that schools that utilize reusable trays spend less than 40% of the cost for disposable trays in the first year of using reusable trays (Cioci 2014). Plastic reusable trays in place of the current single-use trays could potentially reduce the total volume and mass of either trash or compost while concurrently reducing school cafeteria spending.

FIGURE 19

Well-organized sorting station for trash, recycling, compost, liquid waste, and tray/silverware disposal.



Credit: Student Team

Implementation of a Compost System

All schools within the Auburn School District have the opportunity to adopt a lunchroom compost system, as King County compost waste dumpsters were identified outside at all schools' premises visited by UW student teams. Composting was more commonly implemented at elementary schools, and it has the potential to reduce trash waste by 60% for non-composting schools.

Lunch Service

Potential shifts in lunch service protocols could have an impact on both consumption and waste. Project findings appeared to support the idea that students often take more in the lunch line than they eat. However, shifts in menus or how food is served may result in increased consumption and decreased waste. Studies have shown that the youngest students waste the most food, likely because they do not require as much energy as older students (Byker et al. 2014, Niaki et al. 2017). Therefore, reducing portion sizes at the elementary level could reduce the number of whole fruits and other items that are being thrown into waste bins. Federal nutrition requirements for elementary school portion sizes would need to be changed before Auburn schools could actively alter portion sizes, as both content and portion size are federally regulated. In order to continue receiving federal subsidies, Auburn schools need to continue adherence to federal guidelines, including portion sizes of all food items.

Food Rescue Program

Many schools observed in this project currently utilize some form of a food share system. The continuation of this program is recommended with the revision to keep the food share area in an easy-to-access, far-from-waste location. Some observed food share areas were located immediately next to waste bins, which

may deter students from placing or picking up food. While the food share system may be effective in providing extra food for students during lunch periods, most of the food is thrown into trash or compost bins at the end of each lunch period. Therefore, we recommend the remaining food be used in a backpack program for food insecure students to take home any food share items at the end of the school day, or be donated to the local food bank. Elementary schools' lunches are served and eaten in classrooms. Thus, it may be more effective to have food share areas in each classroom that could be collected by custodians, Green Team students, or faculty members to bring to the lunch serving area for classrooms that have not yet received lunch.

A primary potential issue with food share areas is temperature control for items such as milk. One school specifically addressed this by using frozen liquid packs within the food share bins to keep food and beverages cold (Figure 20). This allowed food to be held at an appropriate temperature throughout all lunch periods. This is an easy, affordable way to maintain safe temperatures without investing in additional kitchen equipment, such as a refrigerator or freezer. This food could also be potentially donated at the end of all lunch periods, as is recommended by the USDA (USDA 2012).



Credit: Student Team

FIGURE 20

Food share area with frozen packaging to maintain cold temperatures for milk and other temperature-sensitive items.

Limitations of the Project

The use of an established food waste audit methodology supported by observational data provided reliable data on which to base this analysis and make recommendations. However, this project does have some limitations that must be noted. First, the small sample size ($n=15$ schools) and short observational periods are the greatest limitations, as the sample is not completely representative of the 22 schools in the Auburn School District. In addition, all audits were performed on one day at each individual school and may not be representative of day-to-day waste in these schools. It is possible that longer observation periods would have produced very different findings. Moreover, four separate undergraduate teams

completed individual audits. While all teams were trained by the same King County Green Schools Program representative, potential discrepancies may have occurred due to unexpected items in waste bins, miscommunication across and within groups, and forgetfulness. This was reduced as much as possible with the ease of communication with Auburn School District and other project representatives, as well as with the use of photographs as visual confirmation of correct sorting.

Second, information bias is a potential limitation, as schools were given prior notice that the UW student teams were completing the waste audits on the given dates. Therefore, schools may have been performing beyond their typical daily standards.

Third, this project may not be generalizable to schools nationwide given its small sample size, brief observational period, and specificity to the Auburn School District. While a food share program may be effective in increasing student lunch consumption, reducing food waste, and improving overall waste sorting rates within the Auburn School District, this program may not be effective in districts that do not currently utilize sustainability-focused organizations such as the King County Green Schools Program or have lower food insecurity rates.

Fourth, waste audits may be incomplete because students may throw away food waste in bins outside the lunchroom areas and custodians may not have been instructed to provide these bins to student teams. Compost, recycling, and trash bins may not be collectively available at all waste sorting or disposal points. Similarly, waste audits were not fully representative of kitchen waste as many schools did not deliver all kitchen waste across the lunch periods.

Finally, food share information was not always recorded as rescuable food due to difficulty monitoring the food share areas during lunch periods as well as staff removal of the food items in the share area following the final lunch period. This could have potentially altered counts of food share items.

Future Directions

This project examined current efforts aimed at reducing Auburn schools' lunchroom and kitchen food waste, but future projects should be completed both to confirm these data and to explore potential findings beyond the scope of this project's focus. Some observational data in this project was not supported by analytical data, such as the importance of lunchroom monitors and sustainability advocates. However, Auburn schools emphasized the importance of these for correct waste sorting, and UW students observed the effectiveness of these individuals on Auburn students' ability to correctly sort lunchtime waste. A study similar to the one performed for this project may further explore this anecdotal evidence by means of combining the robust quantitative methods of the waste audits with qualitative interviews and observations to support powerful data. Increased sample size would allow better insight into food waste patterns by allowing for greater statistical power and a more complete view of Auburn students' day-to-day sorting habits. Future studies within the Auburn School District should be completed among all schools on several days

of the week. We suspect that future findings will support the use of lunchroom waste monitors and student Green Teams on improving trash, recycling, and compost rates. Additionally, a study including several days at a single school allows for analysis regarding the effect of menu on food waste rates. For example, less waste and potentially better sorting rates could be expected on a day serving pizza, or other foods students typically enjoy, in contrast to days serving less enjoyable menu items. Studies that obtain data from several time points allow for analysis of metrics beyond those measured in this project.

Additionally, comparison between schools prior to and after implementation of the food share system would be useful in determining the effectiveness of food rescue systems for eliminating excess food waste and for reducing hunger and food insecurity within schools and surrounding communities. This comparison may be completed at all schools currently utilizing food share tables, if waste audit information is available prior to implementation of the food share program. Experimental trials that assign similar schools to either using a food share system or not could provide more powerful data on the effectiveness of food share programs. Efficacy in reducing hunger and food insecurity would be expected to increase among schools utilizing a food rescue program, which may be represented by the amounts of foods retrieved from food share tables by hungry students or the amount of food donated to food banks.

EFFICACY IN REDUCING HUNGER AND FOOD INSECURITY WOULD BE EXPECTED TO INCREASE AMONG SCHOOLS UTILIZING A FOOD RESCUE PROGRAM

Thirdly, a longitudinal study would be useful to examine changes as students transition from elementary to middle and finally to high school in order to understand if sustainability practices taught in elementary schools follow students through graduation within the Auburn school system. This study can either counter or support the data found regarding elementary schools' participation in the King County Green Schools Program, as well as provide analytical data regarding the usage of student-led Green Teams that were only seen in elementary schools. Further, understanding how students retain, react to, or participate in food sorting practices and waste minimization may help better develop best practices for improving sustainability practices.

Finally, a project focused primarily on kitchen food waste would be useful in verifying findings from this study as well as providing further insight into kitchen food waste. This project did not have the capacity to measure the overall food waste from the school kitchens, which may include full, rescuable foods, as well as prepared foods both on the line for student lunch service and in back-of-house hot boxes. Kitchen-focused studies can complement this project, as well as reveal kitchen-related sustainability practices that may further aid in reducing schoolwide food waste. Such a study may also yield critical findings that may aid kitchen waste or excess being added to donation services with a school-to-food-bank program.

06 CONCLUSION

Auburn elementary, middle, and high schools could all benefit from improved food waste reduction programming. Many schools have programs or are participating in best practices in regards to food shares, labelling, waste sorting education, and lunchroom monitoring. While students are generally accurate in their disposal sorting practices of recycling waste, trash and compost rates can still improve. Much of the trash currently generated in school lunchrooms and kitchens can be diverted to compost if all schools implement and adhere to a schoolwide compost system. A districtwide program could also offer potential streamlining of sorting sign design, bin style, and sustained monitoring of waste streams. Participation in the King County Green Schools Program at any level does significantly improve all schools' correct compost and trash rates. Additionally, implementation and adherence to a food rescue program, particularly a food share program, has the potential to rescue over 85,000 calories of food from all Auburn schools in a single day.

REFERENCES

- Adams, MA, Bruening M, Ohri-Vachaspati P, Hurley JC. 2016. "Location of School Lunch Salad Bars and Fruit and Vegetable Consumption in Middle Schools: A Cross-Sectional Plate Waste Study." *Journal of the Academy of Nutrition and Dietetics*. 116 (3): 407-16. doi: 10.1016/j.jand.2015.10.011.
- Amin, Sarah A, Yong, Bethany A, Taylor, Jennifer C, and Johnson, Rachel K. 2015. Impact of the National School Lunch Program on Fruit and Vegetable Selection in Northeastern Elementary School-children, 2012–2013. *Public Health Reports*. 130 (5): 453-457. doi: 10.1177/003335491513000508.
- Auburn Food Bank. 2017. "Our Story." The Auburn Food Bank. <http://www.theauburnfoodbank.org/about/our-story>.
- Byker CJ, Farris AR, Marcenelle M, Davis GC, Serrano EL. 2014. "Food waste in a school nutrition program after implementation of new lunch program guidelines." *Journal of Nutrition Education and Behavior*. 46 (5): 406-11. doi: 10.1016/j.jneb.2014.03.009.
- CalRecycle. 2016. "School Waste Composition." CA.gov. <http://www.calrecycle.ca.gov/reducewaste/schools/Composition.htm>.
- Cioci, Madalyn. 2014. "The Cost and Environmental Benefits of Using Reusable Food Ware in Schools." Minnesota Pollution Control Agency. <https://www.pca.state.mn.us/sites/default/files/p-p2s6-16.pdf>.
- Cohen JF, Jahn JL, Richardson S, Cluggish SA, Parker E, Rimm EB. 2016. "Amount of Time to Eat Lunch Is Associated with Children's Selection and Consumption of School Meal Entrée, Fruits, Vegetables, and Milk." *Journal of the Academy of Nutrition and Dietetics*. 116 (1): 123-8. doi: 10.1016/j.jand.2015.07.019.

- Cohen JF, Richardson S, Austin SB, Economos CD, Rimm EB. 2013. "School lunch waste among middle school students: nutrients consumed and costs." *American Journal of Preventative Medicine*. 44 (2): 114-21. doi: 10.1016/j.amepre.2012.09.060.
- Environmental Protection Agency. 2017. "Food Recovery Hierarchy." Sustainable Management of Food. <https://www.epa.gov/sustainable-management-food/food-recovery-hierarchy>.
- Greene KN, Gabrielyan G, Just DR, Wansink B. 2017. "Fruit-Promoting Smarter Lunchrooms Interventions: Results From a Cluster RCT." *American Journal of Preventative Medicine*. 52 (4): 451-458. doi: 10.1016/j.amepre.2016.12.015.
- Gunders, Dana. 2012. "Wasted: How America is Losing Up to 40 Percent of Its Food from Farm to Fork to Landfill." NRDC Issue Paper.
- Hickey, Michael E. and Ozbay, Gulnihal. 2014. "Food waste in the United States: A contributing factor toward environmental instability." *Frontiers in Environmental Science* 2 (51): 1-6.
- King County. 2013. "Food Insecurity." 2013. Public Health Seattle & King County. http://www.kingcounty.gov/depts/health/data/~/_media/depts/health/data/documents/preventable/food-insecurity.ashx.
- King County. 2016. "Green Schools Program." King County Green Schools Program. <http://your.kingcounty.gov/solidwaste/greenschools/index.asp>.
- King County Solid Waste Division. 2013. "Success Story: Tahoma School District." King County Green Schools Program. <https://your.kingcounty.gov/solidwaste/greenschools/tahoma-school-district.asp>.
- King County Solid Waste Division. 2016. "Success Story: Camelot Elementary School." King County Green Schools Program. <https://your.kingcounty.gov/solidwaste/greenschools/camelot-elementary.asp>.
- Melia, Michael. 2017. "Steamed in the School Caf Over Restrictions on Lunch Sharing." *U.S. News*. <https://www.usnews.com/news/best-states/connecticut/articles/2017-03-01/hangry-in-the-school-caf-sharing-some-food-is-off-the-table>.
- Niaki SF, Moore CE, Chen TA, Weber Cullen K. 2017. "Younger Elementary School Students Waste More School Lunch Foods than Older Elementary School Students." *Journal of the Academy of Nutrition and Dietetics*. 117 (1): 95-101. doi: 10.1016/j.jand.2016.08.005.
- Office of Superintendent of Public Instruction. 2016. "Auburn School District." Washington State Report Card. <http://reportcard.ospi.k12.wa.us/summary.aspx?groupLevel=District&schoolId=111&reportLevel=District&orgLinkId=111&yrs=2015-16&year=2015-16>.

- State of Connecticut Department of Education. 2017. The Use of Share Tables in Connecticut Child Nutrition Programs (CNP), Operational Memorandum No. 6-16. <http://www.sde.ct.gov/sde/LIB/sde/pdf/DEPS/Nutrition/OPmemos/16/OM06-16.pdf>.
- Terry, Melissa. 2017. "School Lunch Share Tables Fight Food Waste and Hunger." Civil Eats. <http://civileats.com/2017/03/27/school-lunch-share-tables-fight-food-waste-and-hunger/>.
- United States Congress. 1996. Model Good Samaritan Food Donation Act, Public Law 104-210. <https://www.congress.gov/104/plaws/publ210/PLAW-104publ210.pdf>.
- United States Department of Agriculture. 2016. "USDA Food Composition Databases." Agricultural Research Service. <https://ndb.nal.usda.gov/ndb/search/list>.
- United States Department of Agriculture. 2016. The Use of Share Tables in Child Nutrition Programs, SP 41-2016, CACFP 13-2016, SFSP 15-2016. https://www.fns.usda.gov/sites/default/files/cn/SP41_CACFP13_SF-SP15_2016os.pdf.
- United States Department of Agriculture Economic Research Service. 2015. "Food Security Status of U.S. Households in 2015." Key Statistics and Graphs. <https://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-us/key-statistics-graphics.aspx>.
- United States Department of Agriculture Food and Nutrition Service. 2012. Guidance on the Food Donation Program in Child Nutrition Programs, SP 11-2012, CACFP 05-2012, SFSP 07-2012. https://www.fns.usda.gov/sites/default/files/SP11_CACFP05_SFSP07-2012os.pdf.
- United States Department of Agriculture Food and Nutrition Service. 2012. Nutrition Standards in the National School Lunch and School Breakfast Programs, 7 CFR Parts 210 and 220.
- United States Department of Agriculture Food and Nutrition Service. 2016. Child Nutrition Programs: Income Eligibility Guidelines, 81 FR 15501. <https://www.federalregister.gov/documents/2016/03/23/2016-06463/child-nutrition-programs-income-eligibility-guidelines>.

A APPENDIX

Amount of Trash, Recyclables, and Compostables, in Pounds (lbs.), at Pre-Sort, Post-Sort, and Mis-sorted by School and Grade Level

APPENDIX

School	Grade Level	Presort Trash (lb)	Presort Recyclables (lb)	Presort Compostables (lb)	Correct Trash(lb)	Correct Recyclables (lb)
A	E	60.85	16.25	65.3	17.95	12.65
B	E	11.02	7.86	44.46	9.38	6.44
C	E	13	21.15	87.41	9.64	14.59
D	E	67.08	8.64	0	13.48	7.34
E	E	36.61	23.16	93.09	25.32	17.36
F	E	106	17.75	0	23.95	16.75
G	E	68.52	7.02	0	15.92	4.66
H	E	8.48	8.6	37.42	5.34	8.24
I	E	5.46	4.6	28.18	4.6	4.7
J	E	44.8	8.26	0	12.44	8.21
K	E	9.15	13.6	41.6	4.55	12.45
L	M	168.67	40.78	0	100.24	19.27
M	M	98.72	12	0	12.71	10.7
N	H	99.8	47.8	132.45	29.7	22.65
O	H	99.45	12.8	0	42.45	6.9

Correct Compostables (lb)	Trash in Recycling (lb)	Trash in Compost (lb)	Recyclables in Trash (lb)	Recyclables in Compost (lb)	Compostables in Trash (lb)	Compostables in Recycling (lb)
64.4	0.7	0.6	1.1	0.3	41.8	2.9
44.16	1.18	0.3	0.26	0	1.38	0.24
86.1	3.55	1	0.85	0.31	2.51	3.01
0	0.32	0	2.26	0	51.34	0.98
90.05	5.11	2.89	0.42	0.15	10.87	0.69
0	0.1	0	3.05	0	79	0.9
0	0.18	0	3.88	0	48.72	2.18
37.42	0.16	0	1.58	0	1.56	0.2
27.66	0	0.22	0.4	0.3	0.64	0
0	0.05	0	0.48	0	31.26	0
41.6	0.55	0	0.7	0	3.9	0.6
0	7.76	0	4.03	0	64.4	13.75
0	1.3	0	3.6	0	81.88	0
109.45	2.55	18.05	7.25	4.95	62.85	22.6
0	2.6	0	6.7	0	50.3	3.3

B APPENDIX

Individual School Reports

The following pages include waste audit reports created by the UW LCY student teams for fifteen different Auburn Schools. Each report presents data on cafeteria waste audits (pre- and post-sort waste, recycling, and compost rates); waste reduction and recycling strategies used; rescuable food recovered; and, provides individualized observations and recommendations. Through better awareness of each school's own waste, recycling, and composting habits, the schools can hope to improve their waste practices. These schools include:

- Alpac Elementary School
- Arthur Jacobson Elementary
- Auburn Mountainview High School
- Auburn Riverside High School
- Chinook Elementary School
- Dick Scobee Elementary School
- Gildo Rey Elementary School
- Hazelwood Elementary School
- Ilalko Elementary School

- Lakeland Hills Elementary School
- Lea Hill Elementary School
- Mt. Baker Middle School
- Pioneer Elementary School
- Rainier Middle School
- Washington Elementary School



2016 - 2017 LIVABLE CITY YEAR

WWW.LCY.UW.EDU