ASSESSING OUTCOMES OF A RECYCLING EDUCATION AND SERVICE PROGRAM WITHIN AN ELEMENTARY SCHOOL

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During the spring 2004 a pilot school recycling program was implemented within Robert E. Lee Elementary. The primary goal of the program was to determine how recycling education in the school would affect curbside recycling rates within the surrounding community. The program was a cooperative effort between the University of North Texas, City of Denton Solid Waste Department and Keep Denton Beautiful.

Throughout the first months of the study during the spring 2004, an increase in curbside recycling within the Robert E. Lee Elementary attendance zone was observed, with a dramatic decrease in participation over the summer and a rapid increase once again during the second full semester of the study. In a survey conducted with 3rd and 5th grade students at the pilot project school, most students expressed positive attitudes about recycling. Students whose survey responses indicated a *high* level of knowledge about what could be recycled were 37% more likely to claim to recycle regularly, than those students that scored low on the knowledge portion of the survey. Although the total amount of waste generation (recyclable and non-recyclable) at Robert E. Lee Elementary did not decrease during the study, the campus was able to divert recyclable material from their trash at a much higher rate than two other local elementary campuses with paper-only recycling and no associated recycling education program.

Based upon the success of the recycling program at Robert E. Lee Elementary, the City of Denton Recycling Division has agreed to move forward with offering recycling to more schools within the Denton Independent School District during the 2005-2006 school year.

ACKNOWLEDGMENTS

I would like to thank the City of Denton Solid Waste Department and Recycling Division for all of their assistance with data collection as well as financial and personal support. Additionally, thank you to Keep Denton Beautiful and the University of North Texas' Elm Fork Education Center for assistance, advice and materials. Thanks to the administration, custodial staff and students at Robert E. Lee Elementary for their participation and involvement.

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CHAPTER I

INTRODUCTION

A Case for Waste Reduction Education

With just a little over one hundred years bridging the gap between modern society and the Industrial Revolution, long gone are the days of considering our natural resources to be unlimited fuel for the industrialized world's unbridled consumption. The world population is quickly approaching 6.5 billion and the ability for each of us to make environmentally sustainable choices is critical. We are depleting our natural resources and generating waste at a per capita rate unprecedented in human history. As our population and economy continue to grow, humans are searching to find ways that more people can survive on less. Less water, less energy, less waste.

This thesis will focus on the issue of waste reduction through education. Each day thousands of tons of valuable material is buried in landfills all over the world. Much of this waste could have been turned into new goods through recycling which has many benefits to our economy and environment. Through recycling humans can decrease the amount of material that has to be stored in landfills, reduce air and water pollution, and decrease natural resource exploitation.

Energy conservation is a primary advantage of recycling. Manufacturing recycled goods typically requires less energy than manufacturing goods from virgin materials. The US Environmental Protection Agency reports that making recycled paper requires 40% less energy than making paper from virgin wood pulp, recycling aluminum uses less than 5% of the energy it took to make the original product, and recycling tin cans reduces the energy needed for manufacturing by up to 74% over using raw material

(USEPA 2005). Recycling not only reduces the amount of energy that must be harnessed during the manufacturing process, but in so doing, significantly diminishes the need to burn fossil fuels to generate that energy.

Air and water quality degradation are emerging as the most significant and immediate environmental threats that we face (Engelman 2005). Recycling reduces air and water pollution, both through the manufacturing and disposal of goods. Paper mills can reduce their air pollution emissions by 74 % and their water pollution by 35 % when they use waste paper stock rather than virgin pulp. Recycling paper reduces our dependence on virgin sources of wood/paper pulp thus reducing the destruction of forest ecosystems and the valuable services they provide (Carless 1992).

Although landfills in the US now operate under very stringent environmental protection regulations, they still present some serious ecological and human health concerns. If leachate, the liquid that comes from garbage, leaks beneath the landfill, it can pollute groundwater. Additionally, organic material that is disposed of in landfills ultimately undergoes some level of anaerobic decomposition, which results in the release of methane gas. When released into the air, methane can cause breathing problems in humans and if trapped in an enclosed space, such as a home, can be highly explosive. Additionally, methane is a known greenhouse gas (Carless 1992).

Finding ways to live in a more sustainable manner is only one part of the solution, we must also find ways to educate and motivate current and future generations in order to curb our destructive behavior. Every child sitting in an elementary school classroom is preparing and practicing for life as a consumer. Schools provide a perfect opportunity to help students discover how their choices impact our planet. By

empowering students to practice sustainable behavior, it may be possible to change the current trend toward unchecked natural resource consumption and environmental degradation.

In order to gain an understanding of the importance of educating young people about solid waste issues, it is valuable to first explore municipal solid waste generation from a broad perspective. In the following section, worldwide, national, statewide, and local solid waste generation will be discussed.

Gaining Perspective on Worldwide Municipal Solid Waste Generation

Municipal solid waste or MSW, as defined by the United States Environmental Protection Agency, is, "trash or garbage… consisting of everyday items such as product packaging, grass clippings, furniture, clothing, bottles, food scraps, newspapers, appliances, and batteries" (USEPA 2003).

According to data collected by the Organization for Economic Co-operation and Development (OECD) of 27 reporting nations, the United States was the world leader in MSW production during 2000, producing 760 kilograms (1,679.60 pounds) per person annually. The next highest producer in 2000 was Canada at 746 kilograms (1644.65 pounds) per person (Statistics Canada 2000). Iceland followed with 710 kilograms (1,569.10 pounds) per person. The lowest MSW producer for 2000 was Mexico with a reported 310 kilograms (685.10 pounds) per person (See Figure 1). The OECD considers waste generation to include material that is generated, collected and then recycled, composted, burned or buried in a landfill (OECD 2004).

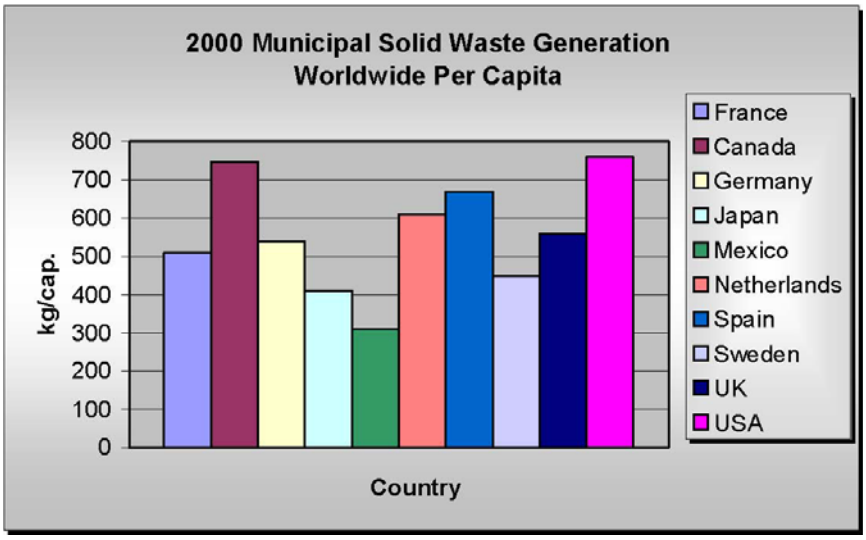


Figure 1. Annual Per Capita Generation of Municipal Solid Waste by Country (OECD 2004)

Municipal Solid Waste in the United States

The United States generated approximately 229.2 million tons of MSW in 2001 (See Figure 2). Nationwide these 229.2 million tons averaged out to approximately 4.4

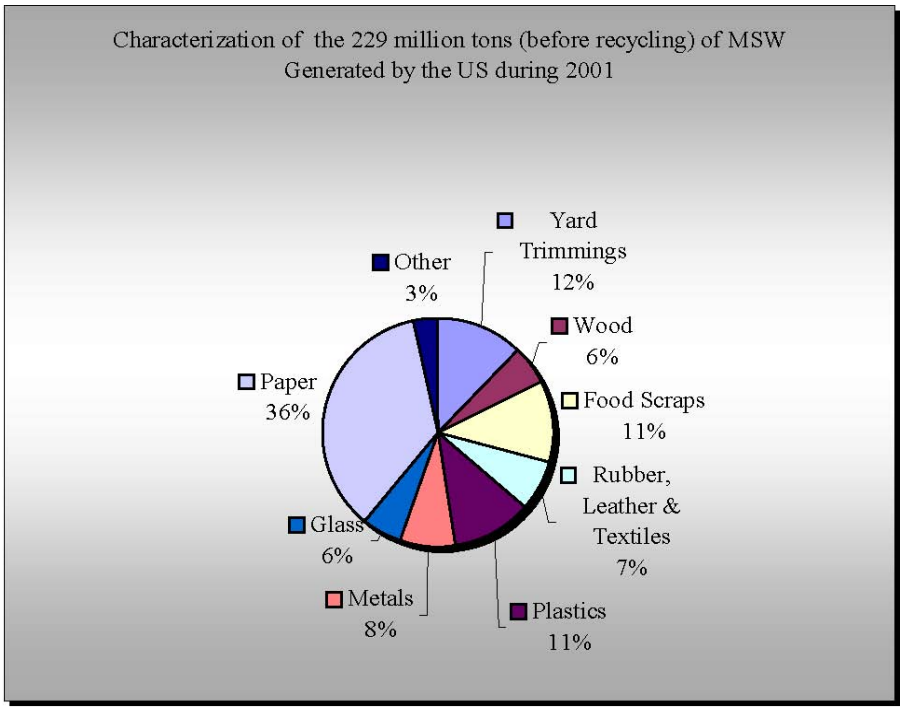


Figure 2. Characterization of U.S. Municipal Solid WasteGeneration as Reported by the US EPA (USEPA 2003).

pounds of trash per person, per day. Per capita landfill disposal of waste (after recycling/composting) in 2001 was 3.1 pounds per day. This number has steadily increased over time from 2.51 pounds per person, per day in 1960 to an all time high of 3.32 pounds per person per day in 1999. In the years since 1999 some decrease in International MSW landfill disposal per person has been observed (EPA 2003).

Municipal Solid Waste Issues in Texas

Although the per capita national solid waste generation rate seems staggering, right here in Texas we are generating more than our fair share of solid waste. In 2002, Texans generated 45,331,858 tons of MSW. Three major sources produced 87 % of this waste. Commercial waste represented 36.5 %, residential waste 28.4 % and construction and demolition waste 22.1 % of all solid waste disposed of in landfills that year (TCEQ 2004).

Texas per capita landfill disposal rate has steadily increased along with the national average to an all time high disposal rate of 7.37 pounds per person per day in 2000. In 2001, there was a slight decrease in disposal to 7.18 pounds per person per day, but generation soon rose to 7.31 pounds per person in 2002. The 2002 Texas average per capita disposal rate was more than two times that of the national average for 2001 (TCEQ 2004).

School Waste Generation and Disposal

School waste is classified as commercial waste. In their 2001 assessment of MSW generation, the U.S. Environmental Protection Agency reported that commercial

waste, which includes waste from schools, makes up between 35 and 45 % of the 229.2 million tons of annually produced MSW (USEPA 2003).

In order to get an idea of the magnitude of waste generated within schools in the United States, data from the U.S. Census Bureau for 2000, which showed the U.S. population to be 281,421,906 people, was combined with the U.S. Department of Education employment and enrollment data for the school year of 2000-2001. These combined data showed that 19 % of the U.S. population was under the roof of a school between 8:00 am and 3:00 pm during the 2000-2001 school year (USCB 2001). Given that between July 1, 2003 and June 30, 2004, 644,939,994 waste generating meals were served in Texas schools with 1,788,190 of those served in the Denton ISD, reducing cafeteria waste alone, not to mention classroom waste, could potentially have a significant effect on the amount of MSW produced nationally as well as locally (TDOA 2004).

Disposing of commercial solid waste is an expensive endeavor. DISD currently operates 22 schools and is slated to open at least one new school every year for the next five years (TEA 2002). Just like many school districts, Denton survives on a tight budget; therefore, it is extremely important to consider how the limited available funds are being spent. After adopting an incentive-based district-wide recycling program, the Lee Elementary County School District in Ft. Myers, Florida was able to reduce their solid waste budget by $169,109 in the 1995-'96 school year (Caylor 1998). With a realistic goal of 25 % reduction in solid waste generation by volume, and appropriate changes to service, the Denton Independent School District has the potential for saving many thousands of dollars annually.

Although recently implemented curbside recycling in Denton has helped to make the community more aware of the value of recycling, when our children go to school, they are not seeing continuity in how waste is handled. If it is not important to recycle at school where students spend most of their day, can we really expect them to understand the importance of recycling at home and supporting businesses that recycle?

Waste Diversion through Recycling

In OECD, EPA and TCEQ figures, generation rates refer to all municipal solid waste that is produced including materials that will be recycled or composted over a given amount of time. A disposal rate refers only to the portion of solid waste generation that is disposed of in a landfill (EPA 2003). The term waste diversion rate typically refers to the quantity of waste materials diverted from the landfill either through recycling, composting or reuse of materials in relation to total solid waste generated during a given timeframe.

In 2002 159,465 tons of municipal solid waste were diverted from Texas landfills through recycling and another 272,213 tons of brush and yard waste were diverted through chipping or mulching (TCEQ 2004). Although this waste was diverted from landfills, it is an important component in the study of the total solid waste generated.

Through the curbside-recycling program, which was implemented in November of 2002, the City of Denton has achieved a 70 % participation rate among those households eligible for curbside recycling service (Sitton 2004). Although combined recycling efforts have been successful in diverting waste from the landfill, the landfill

diversion rate has decreased as Denton continues to grow. During fiscal year 2001-2002, 139,828 tons of solid waste were reported with 31,927 tons or 22.83 % of that material diverted from the landfill through curbside recycling, recycling drop-off sites, paper recycling through the Paper Retriever™ (Abitibi, Consolidated Inc., www.abitibiconsolidated.com) paper recycling program, as well as through the City's internal office paper recycling program, yard waste composting, and asphalt and brick reuse. Fiscal year 2002-2003 showed a slight decrease in landfill diversion with 18.54 % of that year's 131,424 tons of collected waste and yet another decrease was seen during the fiscal year 2003-2004 as the diversion rate dropped to 16.19 % of 145,698 tons collected (See Figure 3).

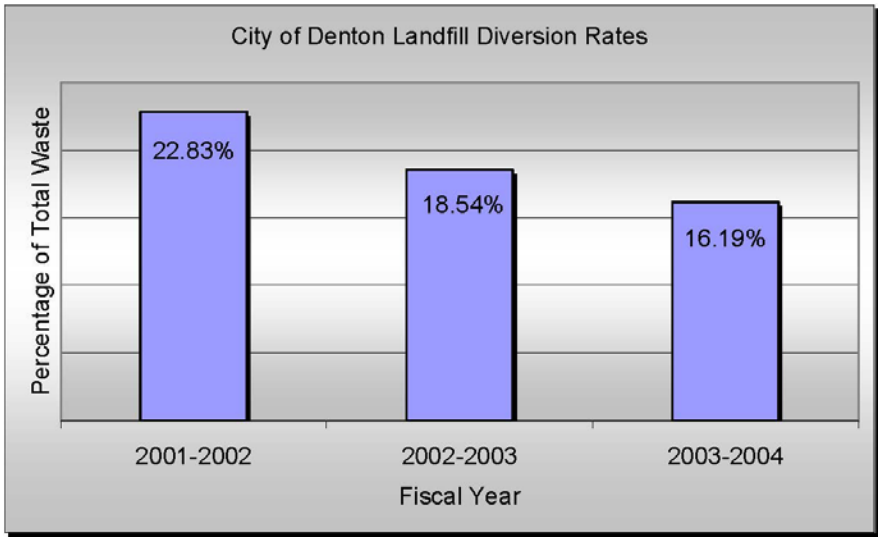


Figure 3. Tons of material diverted from the City of Denton Landfill by fiscal year. Diversion methods include; curbside recycling, Abitibi Paper Retriever, recycling drop-off sites, citywide internal office paper recycling, yard waste composting, and asphalt and brick reuse.

Recycling at School

As part of the Solid Waste Disposal Act of 1989, the state of Texas requires all state agencies, including universities and school districts to, "establish a program for the

separation and collection of all recyclable materials generated…including, at a minimum, aluminum, steel containers, aseptic packaging and polycoated paperboard cartons, high-grade office paper, and corrugated cardboard (Texas 1989).

Denton schools are currently offered optional paper-only recycling services through a monetary incentive based recycling program sponsored by *Abitibi Consolidated*, which is based out of Houston, TX. Abitibi Consolidated processes the paper they collect locally through a Materials Recovery Facility (MRF) in Arlington, TX. Only sixteen schools in the Denton Independent School District have paper recycling through Abitibi, and of those sixteen, only four actively recycle. Abitibi's incentive based program is called the Paper Retriever. Abitibi Consolidated Inc. provides eight cubic yard dumpsters to non-profit organizations, government entities, and some businesses. Participants in the Paper Retrieve program are paid based on the tonnages of paper placed in the provided paper recycling dumpster(s) over a one month period (See Figure 4). Payouts begin at 2 tons. Monthly totals less than 2 tons produce no profit. Monthly totals between 2 tons and 4.99 tons are paid out at $5.00 per ton. Those monthly totals that exceed 4.99 tons are paid at a rate of $15.00 per ton (Abitibi Consolidated 2004).

Neighborhoods surrounding schools are encouraged to dispose of their paper using the Paper Retriever recycling containers located at nearby school campuses. For schools that have heavy community participation, profits can be substantial. Teachers and administrators are resistant to change recycling programs due to this monetary incentive.

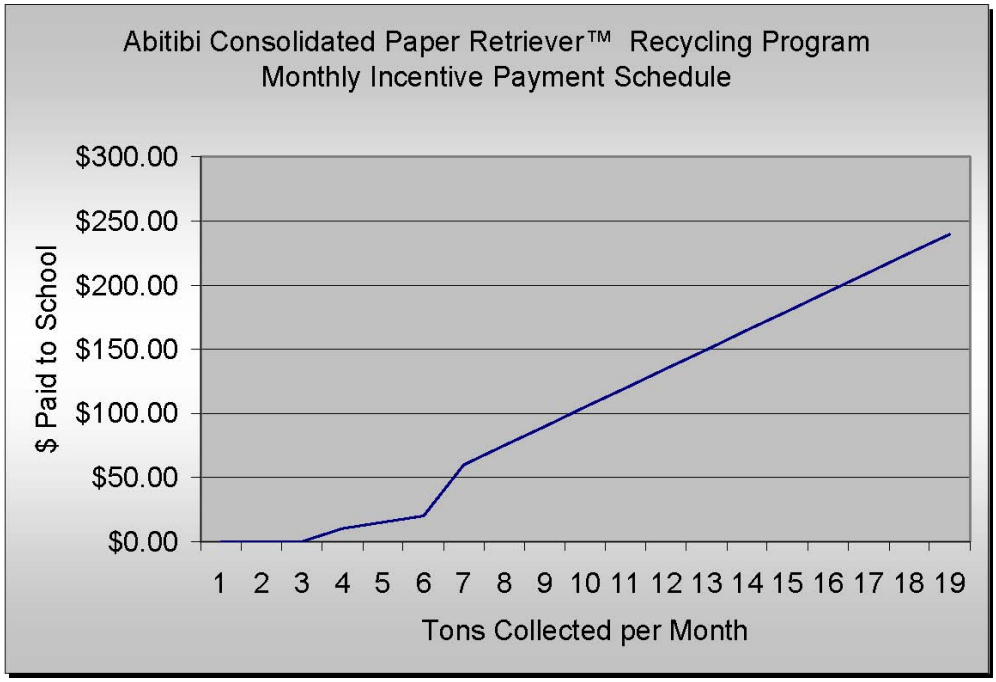


Figure 4. Payment schedule for Denton ISD's Current incentive based Paper Retriever recycling program. It should be noted that payouts begin at 2.00 tons per month. All collections < 2.00 tons receive no payment.

As evidence of how curbside recycling has impacted community participation in the Abitibi school recycling program, between January 2001 and December 2001, Denton schools and residents using the Paper Retriever program recycled 503.18 tons of paper. Curbside Recycling was implemented in November of 2001. With curbside recycling in full swing, between January 2004 and December 2004, 225.30 tons of paper were placed in the Abitibi containers. The district wide recycling rate for the year was lower than ever despite the fact that three additional schools chose to participate in the program between 2001 and 2004 (See Figure 5).

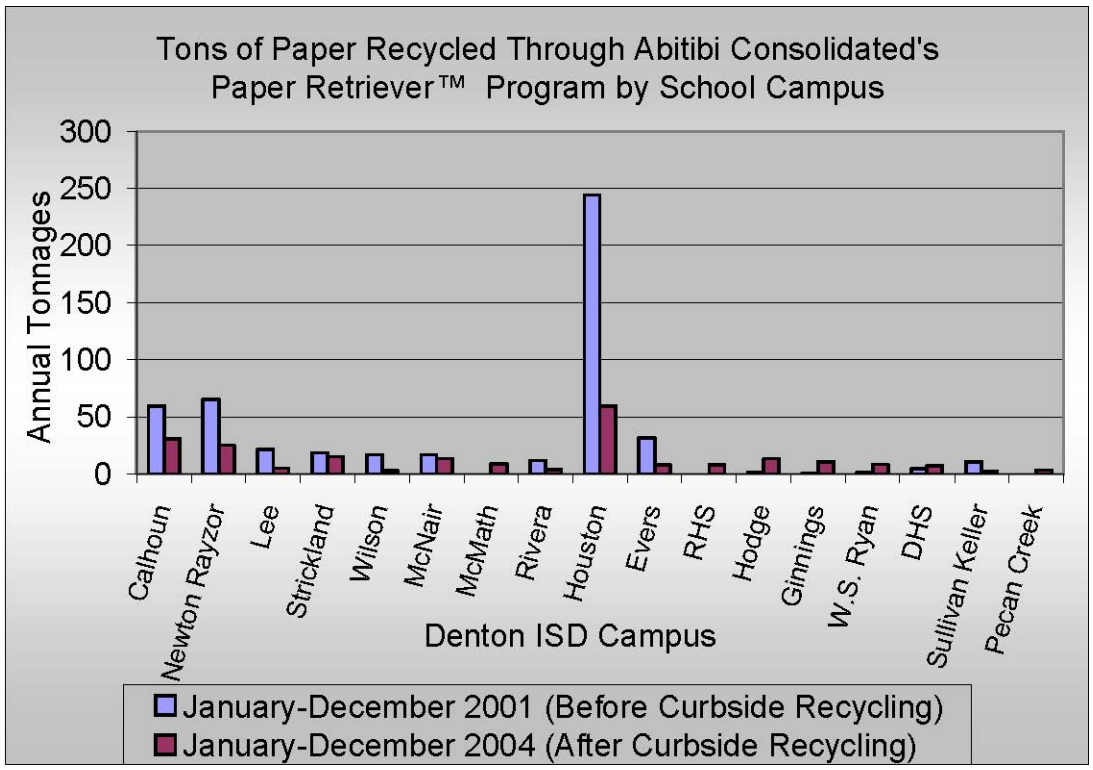


Figure 5. Individual school participation in the Paper Retriever program before, and three years after implementation of the City of Denton Curbside Recycling program.

Other School Districts Implement Successful Recycling Programs

Fortunately, some other U.S. cities have taken advantage if the opportunity to educate entire communities about recycling through their schools. The city of St. Louis has waged an extremely successful public outreach program that includes their in-school programming. In a study conducted by the University of Missouri it was determined that recycling in the St. Louis metropolitan area provides nearly 16,000 jobs and generates nearly $5 billion a year in revenues. This is pertinent to my study, because it implies that a multi-faceted educational campaign can help a recycling program to be successful at the citywide level.

While speaking about a component of the campaign, the *St. Louis Recycled Art Sculpture Contest* Becky Tannlund, Recycling program director for the St. Louis City Refuse Division, stated, “Kids have a lot of power in their households. Many kids take home their recycling message. (And) it’s because kids feel (that recycling is) important and they’re learning to do it at school that adults even consider recycling. In fact, when we meet with neighborhood groups, a lot of times we’re meeting with parents of those kids, and they’ll tell us … ‘We’re recycling now because (our children) have been learning about it in school.’ (Evans 2000).”

Among schools that have tracked the success of in-school solid waste management programs is the San Diego Jewish Academy (SDJA), which has implemented a zero-waste strategy. Through recycling, worm-composting and creative purchasing, the K-12 school reduced waste by 85% over two years. Based on the experiences at SDJA Director of operations Doug Reiss advises, “Expect that it’s going to take a number of years because of the education process … It’s not going to happen overnight (Padgett 2002).” Although, as the data will show, some improvements in recycling rates were observed during the course of the one-year study, it may take several years to actually reach local waste-reduction goals especially in this city, where recycling is a relatively new concept.

Public Knowledge and Attitudes Regarding Solid Waste

In 1998 the National Environmental Education &Training Foundation (NEETF) conducted a survey to study environmental knowledge, attitudes, and behaviors among adult Americans. The survey results indicated that there is a strong positive relationship

between attitudes and behaviors and environmental knowledge. Among those surveyed, respondents rated as *high-knowledge* were 50% more likely to recycle than those respondents rated as *low-knowledge*. Because the NEETF study was conducted with adults, it was important to design a study to evaluate the relationships between knowledge, attitudes and pro-recycling behavior among children for the purposes of this study.

Although their method was cost prohibitive for the purposes of this study, another group employed the survey method to assess knowledge, attitudes and behaviors of students prior to and following implementation of a recycling education program at the elementary school level. This survey was used to examine the effectiveness of classroom education vs. experiential education. The authors of the study concluded that academic classroom presentations changed student behavior by first changing knowledge, but a fieldtrip to a landfill resulted in a difference in behavior due to changes in attitudes. The study findings did not include a report of any changes in solid waste generation or recycling participation within the school. However, the survey design was helpful in determining how to best set up the survey portion of my study (Smith and others 1997). The survey will be discussed in greater detail in Chapter II.

The Role of Recycling in Environmental Education

NEETF defines environmental education (EE) as, “educational efforts that increase public awareness and knowledge about environmental issues while providing critical thinking, problem-solving, and effective decision-making skills.” They go on to state, “The main goal of EE is for people of all ages to know enough about

environmental science and related social issues to make sound and well-reasoned environmental decisions."

Very little published data exist regarding the solid waste produced by schools, or school waste diversion through recycling. No data related to how city wide recycling rates are influenced by pro-recycling education within schools was available at the time of this study. However, volumes of existing environmental education teaching materials deal with solid waste management. The California Department of Education along with the California Integrated Waste Management Board compiled a "Compendium for Integrated Waste Management and Used Oil" which evaluates many of the available curricula (CDOE 2000).

The CIWM Board had each curriculum evaluated by a team of educators for appropriateness at four grade-group levels: K-3, 4-6, 7-9, and 10-12. Only curriculum given an overall grade of B-or above was published in the Compendium. All submitted curricula were carefully screened and one hundred twenty-nine were included in the formal evaluation. Of those, ninety-nine scored above a B-, and thus, were included in the compendium. The Board found that the greatest number of curricula exists for grade levels 4-6 and 7-9. The smallest number of curricula is targeted for grade levels K-3. Their analysis also showed that newer curricula had a more *hands-on* approach to learning.

The California State Education and Environment Roundtable reported that using the environment as an integrating context for learning shows major improvements in student's development of language arts skills and communication with others, as well as a better understanding of and enthusiasm for math, science, and social studies.

Students also showed increased ability to think creatively and problem-solve, and improved interpersonal skills (Leiberman and Hoody 1998). A comprehensive recycling education program in our elementary schools is a great way to provide hands on learning opportunities for students that show how the choices they make each day can positively or negatively affect our environment.

Objectives and Hypotheses

With five primary research objectives, the project began by trying to find ways to reduce the amount of waste generated within schools as well as increase awareness of natural resource conservation and recycling. Throughout the study, the quantities and characteristics of the solid waste streams produced within three elementary schools were monitored to see if educational programming had an impact on waste generation. Additionally, community curbside recycling rates were tracked in order to look for a relationship between the recycling education initiative at Robert E. Lee Elementary and curbside recycling participation within the Lee Elementary attendance zone. Knowledge, attitudes, and behaviors regarding recycling were analyzed to determine if any of the above were influenced by the implementation of a locally managed comprehensive recycling education program.

Upon completion of the study, the City of Denton Solid Waste Department, Recycling Division would like to implement the “Recycling to Make a Difference at School and at Home,” program in all Denton ISD schools. For schools choosing to participate, this program would take the place of any existing recycling programs.

Implementation of the citywide program could potentially serve almost 3,000 faculty and staff members and more than 14,000 students (TEA 2002). Hopefully, in turn, these teachers and students will educate their friends and families thus increasing participation in community wide recycling. The five primary research objectives of this study are as follows:

Objective 1

Characterize the MSW generated by students, faculty, and staff at an elementary school with City of Denton recycling (Robert E. Lee Elementary). Compare this waste to the solid waste generated within a school that has received large monetary incentives through high participation in Abitibi paper recycling (Sam Houston Elementary). Then, compare the waste streams of these two schools to that of a school that has the Abitibi paper recycling program, but received little or no monetary incentives over the last year, due to very low participation (Ronald E. McNair Elementary). Look for similarities and differences in the composition of the waste streams, by volume, that are disposed of in the school's solid waste containers.

Objective 2

Monitor the weight of solid waste and recyclables generated on average per person per day by the students, faculty and staff at Robert E. Lee Elementary before and after implementation of the recycling service and education program. The weight data will be used to measure any difference, over time, in the generation of non-recyclable solid waste as well as to document the amount, by weight, of material diverted from the landfill through recycling.

Hypothesis 1: The mean weight of solid waste generation per person, per day at Robert E. Lee Elementary was not significantly different before implementation of the City of Denton Recycling Program, than the mean weight of solid waste generation per person, per day after implementation (α=0.05).

Objective 3

Compare the weight and volume of solid waste generated within an elementary school with City of Denton Recycling (Robert E. Lee Elementary) to that of a school with high participation in Abitibi paper recycling (Sam Houston Elementary) as well as that of a school with very low participation in the Abitibi paper recycling program (Ronald E. McNair Elementary).

Hypothesis 2: The mean weight of solid waste produced per person, per week in a school with City of Denton Recycling is not significantly different from the mean weight of solid waste produced per person, per week at the two study schools without City of Denton Recycling (α=0.05).

Objective 4

Monitor curbside recycling participation within the Robert E. Lee Elementary attendance zone, before and after the implementation of the school recycling and education program in order to look for any differences in participation over time.

Objective 5

Design and conduct a survey to assess participants' knowledge about, attitudes toward, and behaviors regarding recycling at home and at school before implementation and again after completion of educational programming. Look for differences between 3rd and 5th grade, as well as between male and female survey participants. Also, look for

a correlation between survey participants' level of knowledge about recycling and their tendency to participate in pro-recycling behavior.

Hypothesis 3: Students' level of knowledge regarding recycling is not contingent upon grade level ($\alpha=0.05$).

Hypothesis 4: Students' level of knowledge regarding recycling is not contingent upon gender ($\alpha=0.05$).

Hypothesis 5: Students' level of participation in pro-recycling behavior is not contingent upon gender ($\alpha=0.05$).

Hypothesis 6: Students' level of participation in pro-recycling behavior is not contingent upon their level of knowledge about recycling.

CHAPTER II

METHODS

Choosing Three Study Schools

During July 2003, Keep Denton Beautiful's (KDB) Education Committee decided to focus on promoting the concepts and practices of recycling at Denton Independent School District campuses. The committee conducted a five-question survey to be given to Parent Teacher Association (PTA) representatives in order to gather information about current recycling services within local schools. Although several schools responded that they had minimal paper recycling services provided by Abitibi Consolidated, all respondents requested more information on the implementation of a "comprehensive recycling program," at their campus. The term "comprehensive recycling program" was not defined for survey participants.

Based upon survey responses, the KDB Education Committee decided that a study should be conducted in order to determine the best ways to implement a recycling program within our local schools that would also support and possibly enhance curbside recycling efforts citywide. The committee originally proposed to use two schools as control and contrast campuses. Based upon interest shown through responses to the survey, the committee planned to use a school that receives no recycling services as the control, Ronald E. McNair Elementary, and a school that utilizes Abitibi recycling services, Newton Rayzor Elementary as the contrast. The committee chose Lee Elementary to be the experimental school because the KDB survey showed that they did not have any recycling services. In order to facilitate the study and track its effects on curbside recycling rates, Shirlene Sitton, KDB Education Committee Member and

City of Denton Recycling Division Manager agreed to have the City of Denton Recycling Division assist with the study.

During the fall 2003, the North Central Texas Council of Governments issued a Request for Proposals. This proposed study fit well under the Time to Recycle goal and the specific research objective titled, “Use outreach and education programs to facilitate long-term changes in attitudes about source reduction, reuse and recycling.” In anticipation of the funding, the author was offered an internship with the City of Denton Recycling Division to assist with writing the grant application, and then to conduct the study. The grant was awarded to another city, but the City of Denton Solid Waste Department felt that this study was important and therefore agreed to fund it completely.

Upon commencing with the project, it became apparent that the choices that the KDB Education Committee had made regarding the selected control, contrast and experimental study schools needed to be reevaluated. Although Lee Elementary stated in their KDB survey that they had no recycling services, they actually did have an Abitibi container in front of their school, they just did not use it frequently. McNair and Newton Rayzor also had Abitibi containers. Additionally, the waste stream leaving Lee Elementary was a bit problematic because the school’s dishwasher was broken and therefore all cafeteria prepared breakfasts and lunches were being served on disposable trays. At the time, this was also the case at McNair Elementary but not at Newton Rayzor Elementary. Because a comparison of total waste generation was to be made among the schools, it was necessary to find a way to control for the disposable tray variable. Therefore, three schools that were using disposable, rather than reusable, food trays were selected. First, Sam Houston Elementary was chosen to replace

Newton Rayzor as the contrast school. This school had exhibited high participation in Abitibi's paper recycling program in the past and was also using disposable trays. Houston Elementary is the greatest financial performer through the Paper Retriever™ (Abitibi, Consolidated Inc., www.abitibiconsolidated.com) paper recycling program in the district.

Changing the contrast school also allowed for a comparison between the schools that were realizing a profit through Abitibi and those that were not. This was a big point of contention among PTA representatives within the Denton ISD because there was a perception that all Denton schools were generating substantial revenue through Abitibi. As illustrated in the introduction, this was in fact not the case. In order for the City of Denton to be able to offer competitive service, it was necessary to find out exactly how many schools were actually profiting from the Abitibi program, how much they were profiting, and how the waste stream of the school was impacted by their participation. Uncovering this information led to the discovery that very few schools were actually profiting from their current recycling program.

Robert E. Lee Elementary remained as the school chosen to produce the experimental waste stream. This school is located in a lower income community with 62% of the students coming from economically disadvantaged homes, the highest percentage of economically disadvantaged students in the district. There were 558 students enrolled at Lee Elementary as of October 2004, as well as 80 faculty, administrative, and support staff personnel. The student population was 15% African American, 56% Hispanic, 28% White, 1.1% Asian/Pacific Islander, and 0.4% Native

American (See Figure 6) (TEA 2004). Additionally, 26.2% of the student population was categorized as limited English proficient (LEP) (TEA 2003).

Lee Elementary generated no revenue ($0) through the Paper Retriever Program over the course of the twelve months preceding the study between February 2003 and January 2004 (Abitibi 2004). During the pilot study, the City of Denton Commercial Recycling Division collected and weighed paper as well as co-mingled recyclable materials (glass and plastic bottles and aluminum and steel cans) at Lee Elementary. Additionally, throughout the study, the City of Denton Commercial Recycling Division collected and weighed all trash produced by the school.

Ronald E. McNair Elementary was chosen as the school that would provide the control waste stream because, although an Abitibi paper-recycling container was on the campus, the school had shown no financial profit with the incentive-based Paper Retriever program during the 12 months prior to the study. McNair Elementary is among seven of the sixteen Denton ISD schools that, despite their participation in the Abitibi paper recycling program, showed no profit from recycling over the fourteen months prior to the study, between February 2003 and April 2004 (Abitibi, 2004). As of October 2004, McNair Elementary served 723 students and supported 80 faculty, administrator, and support staff positions. At that time, the ethnic distribution of McNair Elementary was 13% African American, 16% Hispanic, 68% White, 2.2% Asian/Pacific Islander, and 0.7% Native American (TEA 2004). Economically disadvantaged students represented 12.9% of the school population with 2.7% listed as LEP (See Figure 6) (TEA 2003).

The waste stream produced by the experimental school was contrasted with that of Sam Houston Elementary, which has shown a continued financial profit through

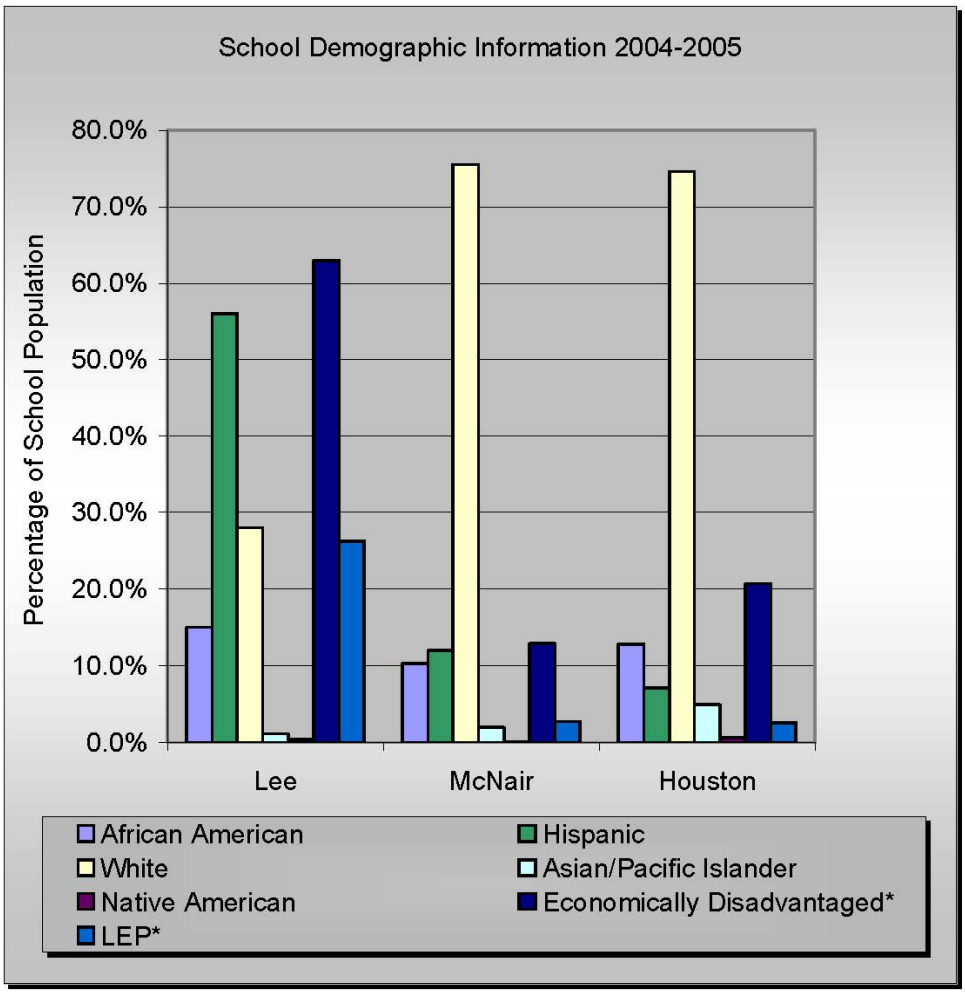


Figure 6. 2004-2005 school year ethnic distributions and economic status of students at Robert E. Lee Elementary, Ronald E. McNair Elementary, and Sam Houston Elementary (TEA 2003, 2004) [Estimates of students who had limited English proficiency LEP or were economically disadvantaged are based on the latest available reported data were for the 2002-2003 school year.]

paper recycling with the Abitibi Paper Retriever program over the last few years. Sam Houston Elementary has no established formal recycling education program, but none-the less; saw revenues of $15,541 through their Paper Retriever Program during the twelve months preceding the pilot study. There were 680 students enrolled at Sam Houston Elementary in October 2004. Seventy-five faculty, staff and administrative positions were also reported. An estimated 20.7% of the student population was from an

economically disadvantaged home. The ethnic distribution was as follows: 16% African American, 9.9% Hispanic, 67% White, 5.7% Asian/Pacific Islander, and 1.3% Native American (TEA 2004). 2.6 % of the school population was considered to be LEP (See Figure 6) (TEA 2003).

Characterizing the Solid Waste from Schools

In order to characterize the waste leaving the elementary schools, a one-week waste characterization study was conducted at each of the schools involved in the experiment. The characterization was based on visual study and waste was categorized into the following groups, Paper, Cardboard, Commingle (bottles and cans), Organics (food and yard waste), and Non-Recyclable Trash (Paper towels, tissues, crayons, pencils, plastic films/bags).

During the waste characterization study period, the commercial recycling crew picked up solid waste from each individual school and weighed it just they had at Lee Elementary. However, rather than weighing the solid waste then immediately taking it to the working face of the landfill for disposal it was placed in a thirty-cubic yard open-top dumpster. These dumpsters have a large swinging door on one end, which allow one toe to walk inside and examine the trash. After the waste was sorted and characterized each day, the recycling crew emptied the thirty-cubic yard containers in order to prepare them for the loads coming from the schools the following day.

In order to determine the quantity of material in each category, an estimate was made regarding the cubic yards of solid waste actually collected from the individual schools each day. Then the percentage of material in each grouping was estimated.

The school district uses clear trash bags, which facilitated a relatively easy sorting process. Bags that appeared to be cafeteria waste (food, disposable trays, milk, mild cartons, industrial sized steel cans, soda cans) were separated from those that contained primarily classroom waste (mostly school papers, paper towels, and tissues), and those that were clearly restroom waste (paper towels). If any household trash was present, it was included in the characterization. Once the bags were sorted, they were then torn open to ensure that the contents were consistent throughout. An estimate of the percentage of total cubic yards present each component (paper, food waste, cardboard, commingled recyclables, actual non-recyclable trash) was made.

Percentage by volume estimates were used in conducting the waste audits, as it was not feasible with the limited personnel and resources of the recycling crew at that time to weigh individual components of the waste generated. Also, characterizing the waste by volume allowed for evaluation of how much solid waste service was actually appropriate for each school involved in the study. At McNair Elementary level of solid waste service was based on two four cubic yard containers and one three cubic yard container all being emptied five days a week. This worked out to twelve non-compacted cubic yards worth of landfill disposal capability per day and sixty non-compacted cubic yards per week. In actuality, during the week of the waste characterization an average of 7.6 cubic yards per day of service were needed even without the City of Denton Recycling Program. On three days of the waste characterization, the three cubic yard container at the McNair campus was completely empty when the driver arrived at the school, so clearly, using the level of service to determine cubic yards of waste generated would not be accurate.

School Waste Generation Data Collection

For clarity, technical vocabulary that will be used throughout this and following sections will be defined as follows. *Solid waste* refers to all materials discarded with the intent of being sent to the landfill for permanent disposal. *Recyclable materials* are those items, which have been discarded in such a way that they can be sold to make new products.

Recyclables are grouped into several categories for the purpose of selling them within the commodities market. *Single-stream* materials consist of all recyclables mixed together (i.e. paper, corrugated cardboard, glass, plastic, steel). *Commingled* material is comprised primarily of bottles, cans, and jars.

There are slightly more obvious recyclable categories such as o*ffice paper*, which is primarily 8.5 by 11 inch white paper, o*ld newspaper* (ONP), and c*orrugated cardboard*. *Mixed paper* consists of all non-coated paper sources mixed together, such as newspaper, office paper, colored paper, magazines, paper bags, and paperboard (e.g. cereal and tissue boxes). *Yard waste* typically refers to leaves, twigs, branches etc. that would normally be generated through residential or commercial lawn maintenance. *Organic waste* can include yard waste, but within the context of this study, the term will be used in reference to waste generated by food handling only. Commodity groupings such as oil, steel, and lumber, are also commonly used within the recycling industry, but are irrelevant to this study.

Long-term goals for the school-recycling program include collecting “single-stream” commercial material in order to better support the existing residential curbside single-stream recycling program. The City of Denton Recycling Division provided blue

residential recycling carts, which were placed in easy to access “Recycling Centers” throughout Lee Elementary. At the time of the study, a market price for single-stream commercial material was still in negotiations. However, agreements had been reached regarding market pricing of commercial commingled material and mixed paper and cardboard. For the purposes of funding the study the Recycling Division requested that paper and cardboard be collected separately from the other recyclables such as steel and aluminum cans, and, plastic and glass bottles.

In order to quantify the amount of waste generated at Lee Elementary before and after implementation of educational programming, all waste leaving the school was weighed beginning in February 2004. By March, two 8-cubic yard recycling containers (one for mixed paper and one for bottles and cans) were placed alongside the school’s two 4-cubic yard solid waste containers.

For the duration of the pilot project at Lee Elementary, the City of Denton Commercial Recycling crew picked up all solid waste and recyclables generated within the school using container trucks that transported the individual dumpsters from the school to the landfill to be weighed. The landfill scales are monitored and calibrated quarterly by the Texas Department of Agriculture Weights and Measurements Regulatory Division, which allows for a ± 20-pound margin of error for these scales. All trucks drove across the landfill scale before and after picking up each load in order to ensure the accuracy of the measured weights. Solid waste was weighed at the landfill scale house before being taken to the working face of the landfill for permanent disposal. The same procedure was followed for recycling containers, but after being weighed, paper and co-mingled recyclables were placed in respectively labeled 40-

cubic yard open top roll-off containers at the landfill. Recyclables from the school were mixed with recyclables from city wide recycling drop off sites then transported and sold to Trinity Recycling (Plano, Texas) when the container was full.

The above method was also used for transporting and weighing solid waste at the control and contrast schools. However, in order to decrease fuel use, emissions, and staff time requirements, the crews later used front load trucks to pick up the solid waste from McNair Elementary. Front loading trucks, are equipped with machinery which allows them to lift solid waste containers and dump their contents, on site, into a larger trailer on the back of the truck. McNair had three separate dumpsters for trash, which not only was an excessive amount of service for the waste they were generating, but it also meant that four trips had to be made to carry the dumpsters back and forth. By using a front load truck, the crew was able to make one trip, and then weigh the entire load rather than making multiple trips each day.

For the purposes of this study, the City of Denton Commercial Recycling Division collected and weighed solid waste at McNair and Houston Elementary schools during the weeks beginning on August 30, September 27, October 25, November 29, and December 13, 2004. The solid waste from each respective school was weighed at the landfill scale house in order to track daily solid waste generation. The daily weights of solid waste per person data that were collected at these schools over the fall semester were compared to those of Lee Elementary during the same weeks in order to evaluate whether or not a comprehensive recycling education program had an effect on total daily per person solid waste generation by weight.

Abitibi Consolidated provided the City of Denton with the tonnages of paper collected from accounts within the City on a monthly basis. These reports were used to estimate solid waste diversion resulting from usage of their containers at the Sam Houston Elementary and McNair Elementary.

Solid waste generation was tracked primarily by weight rather than by volume due to the fact that, as stated earlier, many commercial solid waste customers, including the local school district have a *level of service* greater than their needs actually require. The l*evel of service* is determined by the customer's estimate of how much solid waste they generate and it defines what that customer pays for solid waste service based on the number solid waste containers they have, the volume capacity of those containers, and how often the containers are emptied.

Although Lee Elementary started the recycling project with two four cubic yard containers serviced five days a week, they were not actually generating eight cubic yards of trash per day, or forty cubic yards per week. Additionally, on days that there was a school event such as a fair, the school might actually generate more than their daily allotment of eight cubic yards. Therefore it was more accurate to track the weight of what was actually placed in the dumpsters, than the potential volume. Solid waste generation before and after implementation of the recycling program at Lee Elementary was analyzed using an independent t-test ($\alpha=0.05$).

Monitoring Curbside Recycling Participation

In addition to understanding the volume and composition of a school waste stream, the City of Denton Recycling Division also wanted to determine if a school

recycling program which reflected the design of the curbside recycling program, would have an affect on city wide curbside recycling rates. In order to study whether or not the pilot recycling program had any impact on recycling within the community, the curbside recycling participation rate within the Lee Elementary School district was monitored throughout the study.

In order to track changes in curbside recycling participation during the study period, the Lee Elementary attendance zone was mapped out then split into three units to divide up the workload and ensure that as many curbside recycling carts as possible were counted before being emptied by Trinity Waste Services and moved back inside for the week by residents. One person was assigned to count curbside recycling carts within each of the three units. During the 2nd and 3rd weeks of November 2003, recycling carts were counted within the attendance zone starting at 8:00 am Thursday mornings, the regularly scheduled pick-up day for that section of the city. Preliminary counts were performed starting in November 2003, before any promotion of in school recycling began. Curbside recycling participation was tracked in this same manner throughout the study. When the data collection period was completed, the counts were compiled onto a spreadsheet. From there it was possible to calculate the curbside recycling participation rate by dividing the number of carts present each day, by the total number of households within the Lee Elementary attendance zone that were eligible for curbside recycling service. Curbside recycling service in Denton is currently limited to single-family homes.

Survey Data Collection and Evaluation Methods

Both nationally and locally, environmental education standards fall within the confines of science and social studies educational standards. The National Science Education Standards as established by the National Research Council and endorsed by several agencies including the U.S. Department of Education outline specific standards for science education in the U.S. (NRC 1996). The state of Texas has established the Texas Essential Knowledge and Skills (TEKS). Locally, the Denton ISD has adopted a "Science Scope and Sequence" to guide teachers and students through the process of meeting the national and state science education standards.

Recycling Education aligns with science standards at most grade levels, because it encourages knowledge of what natural resources are, how they are used, and the importance of conserving them for the future. Although these principles can be applied at many grade levels, examples for 1st through 3rd grade are listed in Table 1.

Table 1. First through third grade national, state and local educational standards, by grade, which are supported by a recycling education program (NSES 1996, TEKS, 2001, DISD, 2004).

	1st Grade	2nd Grade	3rd Grade
NSES	Standard D Earth and Space Science Standard F Science in Personal and Social Perspectives	Standard D Earth and Space Science Standard F Science in Personal and Social Perspectives	Standard D Earth and Space Science Standard F Science in Personal and Social Perspectives
TEKS	(1.10) (C) Science Concepts. The student knows that the natural world includes rocks, soil, and water. The student is expected to: Identify how rocks, soil, and water are used and how they can be recycled. (1.1) (B) Scientific processes. The student conducts classroom and field investigations following home and school safety procedures. The student is expected to learn how to use and conserve resources and materials.	(2.1) (B) Scientific processes. The student conducts classroom and field investigations following home and school safety procedures. The student is expected to learn how to use and conserve resources and dispose of materials. (2.10) (B) Science Concepts. The Student knows that the natural world includes rocks, soil, water, and gases of the atmosphere. The student is expected to identify uses of natural resources.	(3.1) (B) Scientific processes. The student conducts field and laboratory investigations following home and school safety procedures and environmentally appropriate and ethical practices. The student is expected to make wise choices in the use and conservation of resources and the disposal or recycling of materials. (3.11) (A) Science concepts. The student knows that the natural world includes earth materials and objects in the sky. The student is expected to identify and describe the importance of earth materials including rocks, soil, water, and gasses of the atmosphere in the local area and classify them as renewable, nonrenewable, or inexhaustible resources.
Denton ISD Student Performance Objectives:	(1) (S2.2) The student will learn how to use and conserve resources and materials in the classroom by using the recycling bin and by not wasting class resources and materials during investigations. (1) (S5.1) The student will be able to discuss identify, and illustrate how the basic needs of living organisms are met and affected by the availability of Earth's resources. (1) (S7.1) The student will identify and describe natural sources of water and describe differences between rock, soil, and water as well as how much is used and/or recycled.	(2) (S2.2) The student will demonstrate conservation of resources by appropriate recycling and through proper disposal of material used during science investigations. (2) (S7.2) The student will identify uses of natural resources.	(3) (S7.1) The student will identify and describe the importance of earth materials including rocks, soil, water and gases of the atmosphere especially those in the local area and classify them as renewable, nonrenewable, or inexhaustible resources. (3) (S7.2) The students will be a responsible caretaker of the environment by exhibiting the ability to conserve resources and recognizing that the supply of many resources is limited and that resources can be extended through recycling and decreased uses, such as through turning of lights, closing doors and/or blinds, turning off water while brushing teeth or washing hands, and only taking what you will use.

In order to better understand what students have learned in school and at home about recycling and how that knowledge affects the behaviors a survey was conducted with 3rd and 5th grade students at Robert E. Lee Elementary. Approval to use human subjects during the survey portion of the study was granted through Institutional Review Board at the University of North Texas.

The only populations directly sampled were 3rd and 5th grade students and teachers at the Robert E. Lee Elementary. All potential participants were informed that survey responses would be used for the purposes of this study only and that participants' identities would not be associated with their responses.

Each student was provided with a parent consent form as well as a student assent form. The forms explained the intent of the study as well as any risks associated with participating in the survey. All participating teachers were required to sign an assent form as well. Students were only allowed to participate if they had returned the aforementioned consent and assent forms with signatures. The students were given one week to return the forms. After one week, very few forms had been returned by either grade so the deadline was extended by one week. Again, a limited number of forms were returned. An additional set of forms was then sent out with a personalized letter in English and Spanish. Students were given one more week for a total of three weeks to return the forms. Of the 169 students that were invited to participate, only 91 returned their forms and were eligible to take the survey. Of those 91 students, only 81 were actually present to take the fall 2004 survey and 77 to take the spring 2005 survey. The surveys were conducted in the 3rd and 5th grade classrooms at Lee Elementary.

Five 3rd grade classes and three 5th grade classes agreed to participate in the survey. One 3rd grade class chose not to participate.

On November 18, 2004 eligible and present 3rd and 5th grade students from participating classes at Lee Elementary responded to a thirteen-question survey targeted toward evaluating their knowledge, attitudes and behavior regarding recycling at school and at home. The survey responses were tallied in order to look for trends and associations between knowledge and pro-recycling behavior. On May 2, 2005 the same group of students that participated in the November 2004 survey was asked to once again respond to the same thirteen questions in order to determine if there had been any increase in knowledge or pro-recycling behavior over time.

After reviewing how students responded to the first survey, there were several questions that were determined not to provide insightful information, either because students did not understand the intent of some questions or because the questions were not asked in a way that was conducive to gaining insight to the students' perspectives. Therefore, although these questions were still included in the second survey, analysis focused on responses to the specific questions that appeared to be the best understood and most helpful in assessing the students' attitudes, knowledge and behavior.

Once students specified their gender, they were asked to complete the sentence, "I think that people who recycle are_____." While analyzing the results of both the first and second surveys, words and phrases that students used to describe people who recycle were grouped into positive attitudes and negative attitudes.

The evaluation of students' pro-recycling behaviors was based upon their responses to two questions (See Appendix B Recycling Survey #5 and #6) regarding the frequency with which they recycled at home and at school. In both situations, students were asked to choose one response from a list of phrases related to frequency of pro-recycling behavior. In the first question the students were asked how often they used the recycling bin at home. In the second question, they were to report how frequently they use the recycling bin at school. In both cases, students were given the choices, "Once a week," "Once a day," "Several times a day," and "Never." Each student's responses were characterized based upon the combined level of participation in prorecycling behaviors at home and at school. Students that responded that they recycled once a week or less to both questions were rated as *low* level participators. Due to the large amount of recyclable materials at home and at school, and the easy access to recycling in Denton either through curbside or drop-off site recycling, students who claimed to recycle once a week or less, were determined to be lacking pro-recycling behavior at any considerable level. Those survey respondents that claimed to recycle at least once a day either at home or at school but not both, were rated as *moderate* level participators, and those who recycled once a day or more both at home and at school were rated as *high* level participators.

The recycling knowledge assessment was based primarily on two questions (See Appendix B Recycling Survey #12 and #13) that tested students' ability to identify items that could be recycled through the City of Denton's recycling programs. In both questions students were given a list of twelve items and asked to circle only those that could be recycled either at home or at school. The percentages of items that were

identified correctly in both lists were calculated. Then scores for the two questions were averaged. Students that, on average, identified less than 50% of the items correctly were rated as having a *low* level of recycling knowledge. For those scoring between 50% and 69% a rating of *moderate* recycling knowledge was assigned. Finally, student's who identified 70% or more of the items correctly were rated as having a *high* level of knowledge regarding recycling. Chi square correlation tests were used to determine whether or not students' tendency to participate in pro-recycling behavior was contingent upon grade level, gender or the level of knowledge about recycling, (α=0.05).

Recycling Education

In order to expose the students at Robert E. Lee Elementary to as much information regarding recycling as possible following the August 2004 survey, all Lee Elementary teachers were contacted and informed about the study. Teachers were also offered the opportunity to have recycling activities that were aligned with state and district science educational standards conducted in each of their classrooms.

Three recycling stations were designed and set up within the school. Each recycling station housed two thirty-two gallon curbside recycling carts (See Appendix C, Figure 15). Signs were placed on the carts designating one for paper and cardboard, and the other for bottles and cans. Additionally, signs were hung above each cart illustrating which natural resources were conserved by choosing to recycle the items in the cart beneath the poster. Throughout the first semester, several recycling related contests were held. For the first contest, I monitored classroom waste bins for anything that should have been put in the recycling container, and then rewarded the classes that

were able to keep all recyclables out of their trash for an entire week (See Appendix C). Later in the year, a contest was held to encourage classes to set up recycling centers in their classrooms (See Appendix C). The centers were required to have a container for paper, as well as a container for bottles and cans. They needed an area for materials that could be reused, such as pencils, crayons, and clean paper or colored paper scraps. Lastly, each center was required to have a posted schedule for students to take recyclables from their classroom to the recycling station where the recycling carts were located. A winning class was selected from each grade level, and the City of Denton's Recyclesaurus Rex mascot visited each class with prizes such as Frisbees and pencils made from recycled material.

Another recycling promotion took place around the Christmas holiday. All Lee Elementary classes were asked to design and create an ornament entirely from reused materials. Students were given guidelines such as the maximum dimensions for the ornament and suitable types of materials. The ornaments hung on the City of Denton Recycling Division's holiday tree during the holiday lightning festival on the square. After the event, the decorated tree was moved to the customer service waiting area at City Hall East for the month of December 2004.

Along with the above contests and promotions, the school administration was asked to announce recycling accomplishments during the morning announcements. Flyers were sent home with students to keep their parents aware of the students' recycling efforts with hopes of opening up a dialogue about recycling at home.

On October 14, 2004 the program and its accomplishments were presented to the Robert E. Lee Elementary PTA at a special meeting attended by the district

superintendent as well as other school district leaders. Teachers and parents responded very positively and many teachers showed interest in having someone visit their classrooms to discuss recycling with the students.

Finally, the City of Denton Public Information Office produced two educational music videos about recycling and composting. Both videos featured students from Lee Elementary and each included a credit to the school at the end. The recycling music video was aired for several weeks during programming targeted toward children, on Charter Cable and the composting video was aired frequently on the “Denton Television Channel”. This allowed the students at Lee Elementary to not only see themselves on television, but also show other local kids that Lee Elementary was participating in the school recycling program.

CHAPTER III

RESULTS

Waste Characterization

Over the course of the one-week waste characterization study, the daily average of recyclable paper that was disposed of in the solid waste containers at McNair Elementary was around 41% (See Figure 7). This was much higher than that of Sam Houston Elementary at 19% (See Figure 8) and ten times higher than the daily average at Lee Elementary of 4% (See Figure 9). The total amount of cardboard in the solid waste containers was relatively low making up between 1% and 7% of the daily average volume from all three schools. McNair was again had the highest percentage of recyclable material in the commingled category at a daily average of 11%. Lee Elementary's daily average of bottles and cans disposed of in the solid waste containers was around 3%. Organic waste from the cafeteria accounted, on average, for 29% of the solid waste by volume from McNair Elementary, 20% from Sam Houston Elementary, and 27% from Lee Elementary. Non-organic waste that could not be recycled under currently available recycling services was categorized as trash.

In a setting where recycling services are being fully utilized, the majority of material that is treated as trash and disposed of in a solid waste container destined for the landfill should be non-recyclable. Of the total volume of material in the solid waste containers at McNair Elementary, approximately 14% was actual non-recyclable trash.

This indicates that roughly 86% of the material, by volume, in the solid waste container could have been recycled if recycling service was available (See Figure 7). At Sam Houston Elementary 48% of the waste could be characterized as non-recyclable

trash (See Figure 8) and at Lee Elementary 65% of the material that was treated as trash, was actually non-recyclable trash (See Figure 9, also see Appendix A).

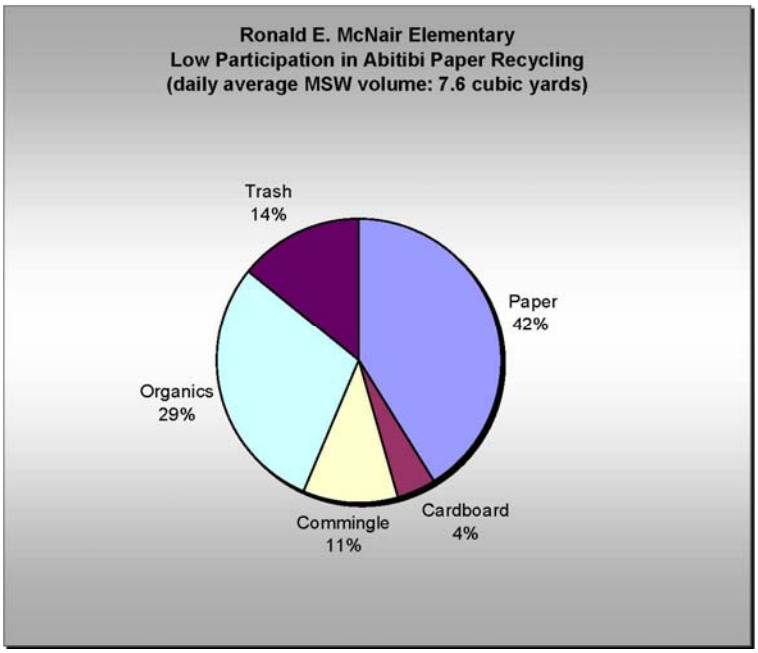


Figure 7. Daily average percentages by volume of material found in City of DentonSolid Waste Department dumpsters at McNair Elementary. Recycling containercontents are not included in this figure.

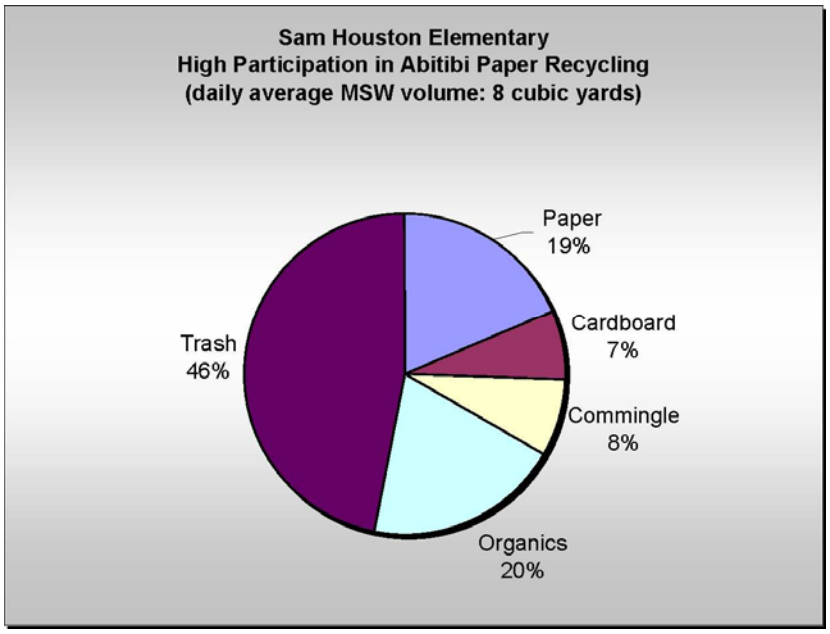


Figure 8. Percentage by volume of material found in City of Denton Solid Waste Department dumpsters at Sam Houston Elementary. Recycling container contents are not included in this figure.

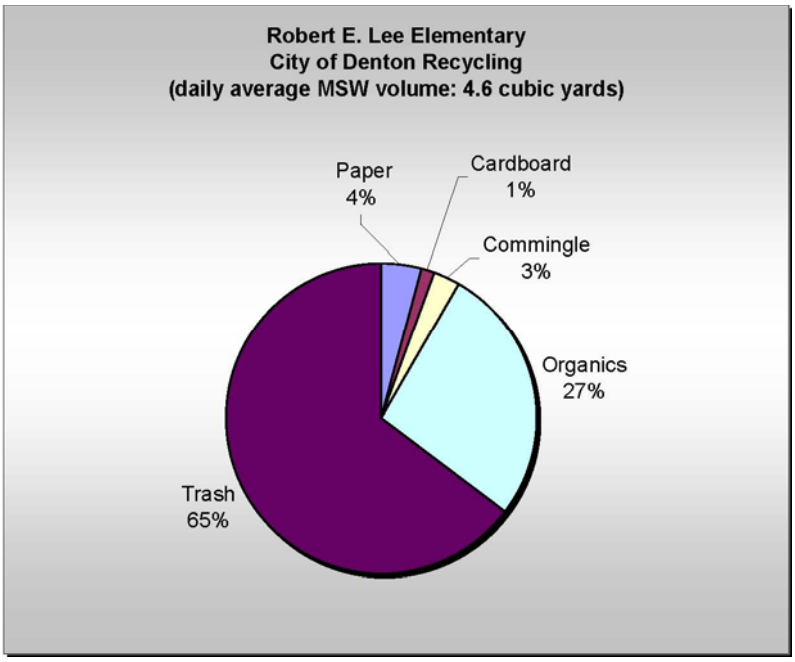


Figure 9. Percentage by volume of material found in City of Denton Solid Waste Department dumpsters at Robert E. Lee Elementary. Recycling container contents are not included in this figure.

Weight and Volume of Solid Waste Generation

There was a small decrease in the total amount of solid waste generated by students, teachers, and school administrators after implementation of the school recycling program at Robert E. Lee Elementary (See Table 2).

Table 2. Solid waste generation at Robert E. Lee Elementary, by weight per person per day during the first month before the educational programming began as compared to the first full month after implementation

February-04	Lbs per person per day	April-04	Lbs per person per day
Week 1	1.06	Week 1	1.04
Week 2	0.99	Week 2	0.72
Week 3	0.82	Week 3	1.17
Week 4	1.17	Week 4	0.99
Feb Avg	1.01	Apr Avg	0.72

*Educational programming and recycling promotions began within the school in March 2004, but due to Spring break, April was the first full month after implementation.

Over the course of the pilot study there were also some dramatic fluctuations in the weight of total waste generated within Lee Elementary. Sharp increases in generation were seen during the first and last months of the two encompassed semesters (See Figure 10). Total generation of waste per person, per day by weight did not decrease significantly as a result of the school recycling program, however as a result of their recycling efforts, Robert E. Lee Elementary diverted 33.39 tons of recyclable material away from the landfill during the period between February 2004 and January 2005.

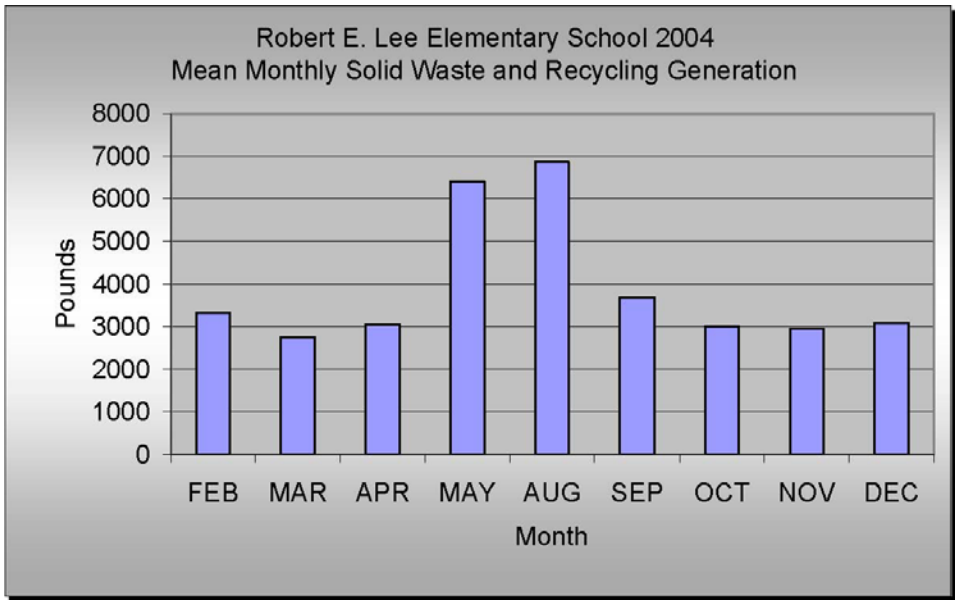


Figure 10. Mean monthly weights in pounds of solid waste and recycling generated by students, faculty and staff combined, at Robert E. Lee Elementary during 2004. MSW weight generation data were not collected during the summer months of June and July.

Mean per person waste Generation showed similar trends to those of total school waste production during the study period (See Figure 11).

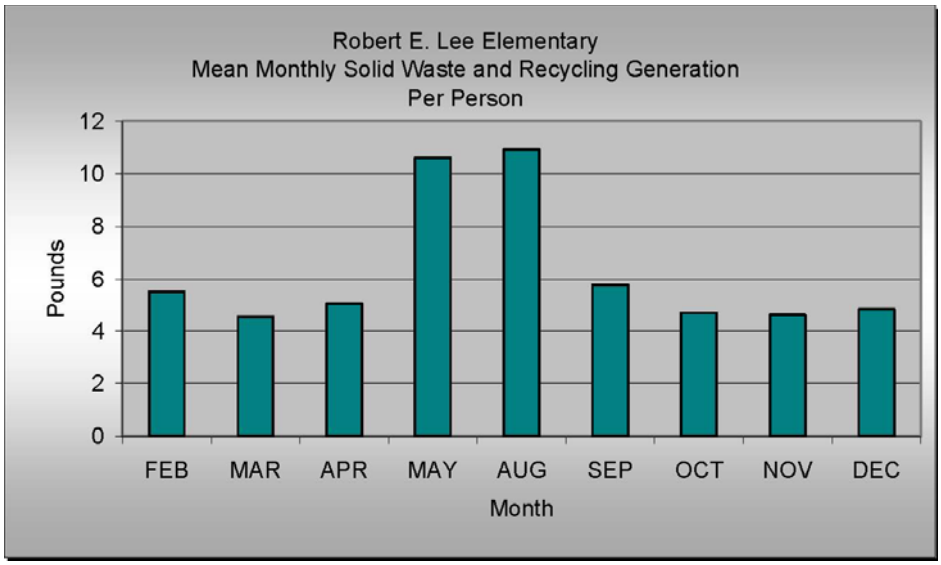


Figure 11. Mean monthly waste generated per person within Robert E. Lee Elementary. Per person calculations are based on total number of students, faculty and staff. [For the spring 2004 semester there were 604 people to account for and during fall 2004 the school population had increased to 640. MSW weight generation data were not collected during the summer months of June and July.]

The percentage of waste diversion, by weight, through recycling ranged between 10% and 20% of total waste produced throughout most of the study. There was a dramatic increase to 44.18% diversion during May 2004, the last month of the spring 2004 semester (See Figure 12).

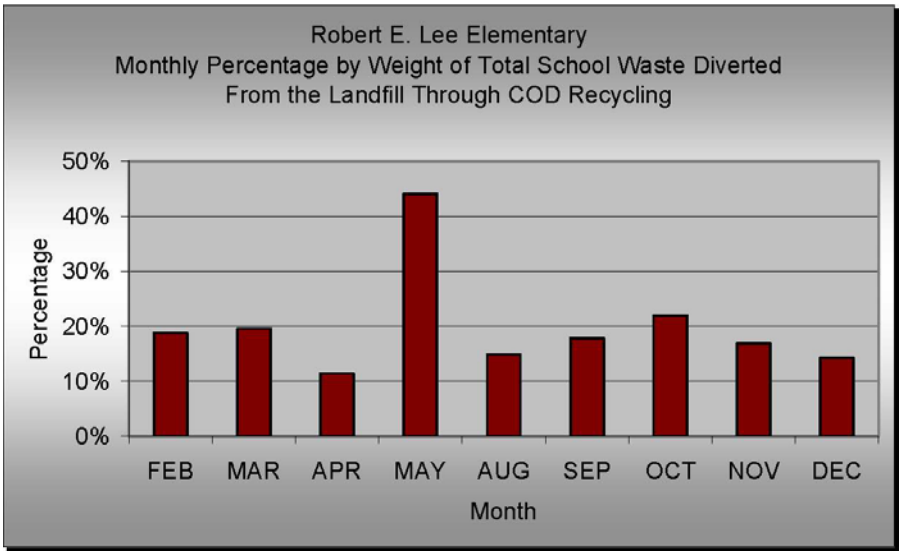


Figure 12. Monthly percentage of school waste diversion at Lee Elementary.

Through the landfill diversion brought on by their recycling efforts, Lee Elementary was able to reduce the required level of service for solid waste from forty cubic yards per week to twenty-four cubic yards per week. This implies a 40% reduction in solid waste generation by volume.

McNair Elementary, which shows very little participation in the Abitibi Paper Retriever™ (Abitibi, Consolidated Inc., www.abitibiconsolidated.com) paper recycling program, generated less waste per person per day than Lee Elementary even after implementation of recycling at Lee Elementary. Additionally, the mean weight of solid waste generated per person per day in pounds at Sam Houston, which has high participation in the Paper Retriever program, was less than both Lee Elementary and McNair (See Table 3).

Table 3. Average solid waste per person per day in pounds, generated within the three study schools.

Week of:	Lee Elementary	McNair Elementary	Houston Elementary
8/30/2004	2.08	1.69	1.98
9/27/2004	0.79	0.29	0.49
10/25/2004	0.79	0.61	0.76
11/29/2004	0.71	0.48	0.51
12/13/2004	0.85	0.77	0.70
Campus Average	1.04	0.77	0.89

Curbside Recycling Participation Rates

Curbside Recycling Participation Rates as illustrated in the figures below, at the onset of the study, curbside recycling participation rates within the Robert E. Lee Elementary Attendance Zone showed that approximately 38.10% of the eligible 1,890 homes set there recycling cart on the curb for pickup on their scheduled recycling day. By the end of the study 39.63% of the homes within the attendance zone were participating in curbside recycling (See Figures13 and 14).

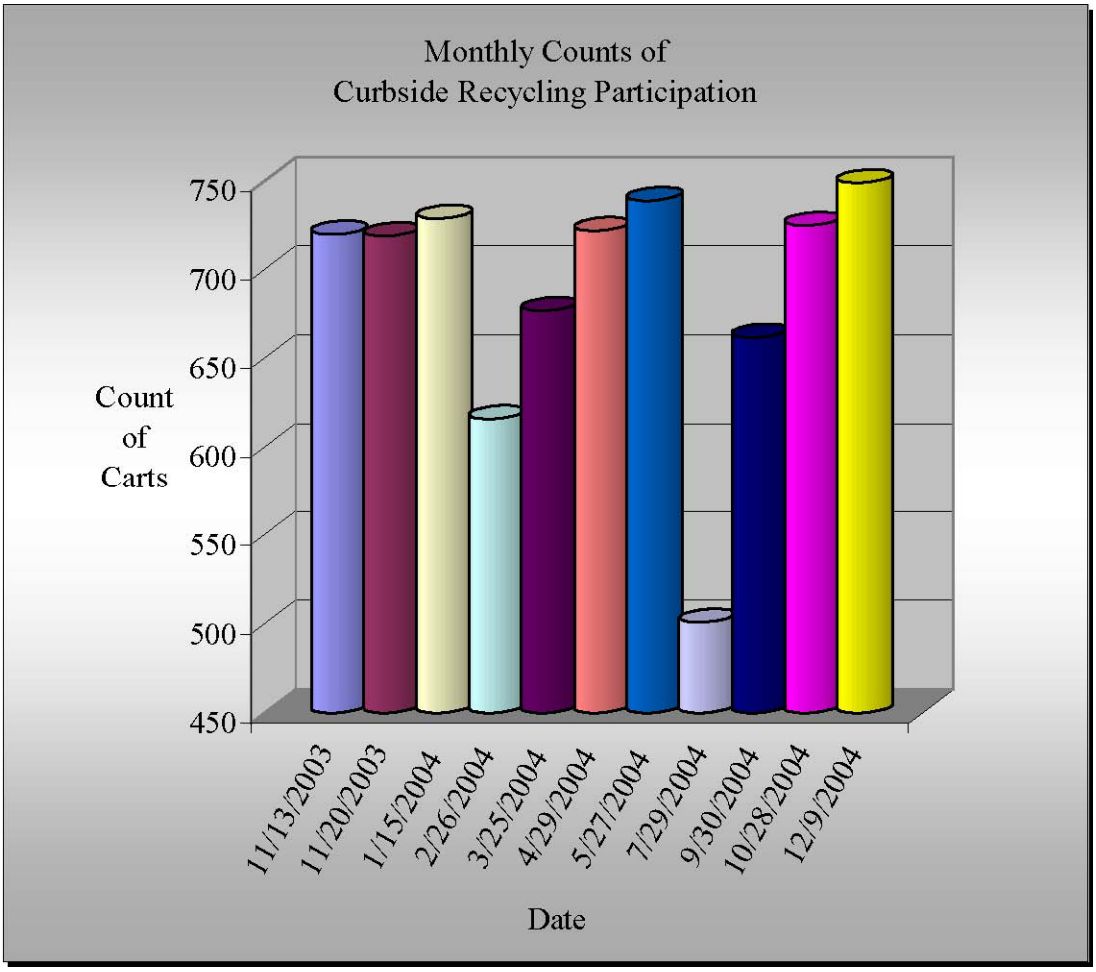


Figure13. Curbside Recycling participation within the Robert E. Lee Elementary attendance zone for the period between November 13, 2003 and December 9, 2004. In-school recycling began in January 2004.

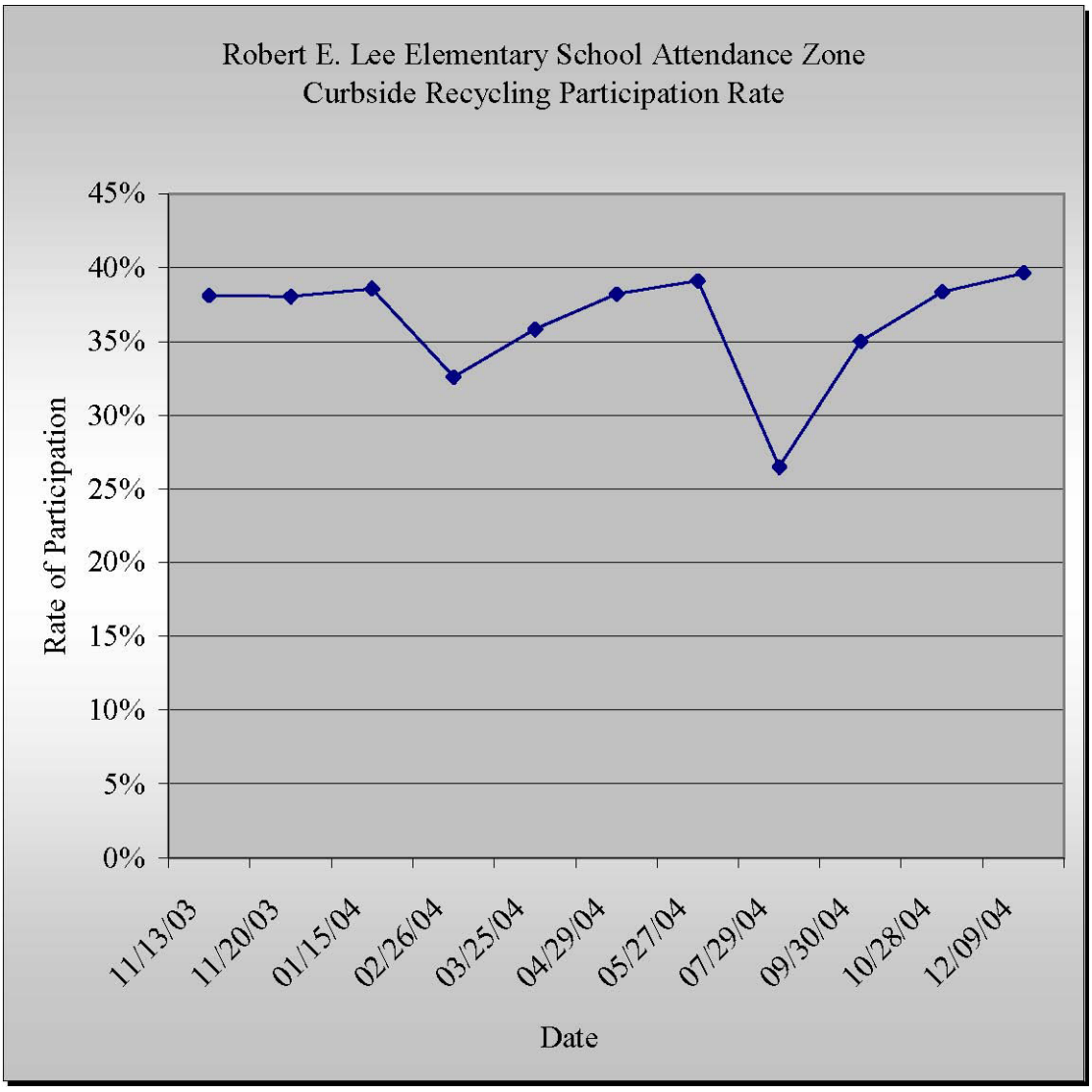


Figure 14. Curbside recycling participation rates as tracked over the course of the pilot study. Participation rate= number of recycling bins placed on the curb for scheduled pickup/ total number of single-family homes in the zone (1,890 homes).

Knowledge, Behavior and Attitudes Survey

The majority of students that participated in the first Recycling Survey scored in the *moderate* range (50-69% correct) on the knowledge portion of the survey. At 42.10% a slightly higher percentage of 5th graders scored in the *high* knowledge range (70%+ correct) than 3rd graders did at 35.71% (See Table 4). Although students scored

lower in general knowledge portion of on the second survey, the trends between the grades were similar. Fifth graders fared slightly better than 3rd graders and the majority of 3rd graders scored in the *moderate* range as opposed to the majority of 5th graders who scored in the *high* knowledge range (See Table 5).

Table 4. Percentages of Students scoring *low*, *moderate*, and *high* on the knowledge portion of the **first** recycling survey, by grade level. (3rd grade N=42; 5th grade N=39)

Low (<50% correct)	Moderate (50-69% correct)	High (70%+ correct)
4.76%	59.52%	35.71%
7.89%	50%	42.10%

Table 5. Percentages of Students scoring *low*, *moderate*, and *high* on the knowledge portion of the **second** recycling survey, by grade level. (3rd grade N=42; 5th grade N=39)

Low (<50% correct)	Moderate (50-69% correct)	High (70%+ correct)
8.82%	55.88%	35.29%
13.95%	39.53%	46.51%

The majority of males and females that were surveyed achieved a *moderate* knowledge score. Males' scores fell into the *moderate* knowledge category more frequently than they fell into the *high* knowledge category. More females achieved *high-ranking* scores than *moderate* or *low* (See Table 6 and Table 7).

Table 6. Percentages of students scoring *low*, *moderate*, and *high* knowledge on the **first** survey, grouped by gender.

	Low	Moderate	High
Male N=46	6.52%	54.35%	39.13%
Female N=35	8.57%	40.00%	51.43%

Table 7. Percentages of students scoring *low*, *moderate*, and *high* knowledge on the **second** survey, grouped by gender.

	Low	Moderate	High
Male N=44	13.64%	47.73%	38.64%
Female N=33	9.09%	42.42%	48.48%

Seventy-eight percent of the students that scored in the *high* knowledge range on the first survey indicated that they recycle more than once a day both at home and at school. Fifty percent of the students that scored in the *moderate* knowledge range reported recycling this regularly, and 40% of students that scored *low* on the knowledge portion of the survey reported recycling regularly at home and at school. In the second survey, the percentages were slightly different but still reflected the same trend (See Tables 8 and 9).

Table 8. Percentages of students who scored *low*, *moderate*, and *high* on the knowledge portion of the **first** survey and reported to recycle at least once a day both at home and at school.

Low	Moderate	High
40%	50%	78%

Table 9. Percentages of students who scored *low*, *moderate*, and *high* on knowledge portion of the **second** survey and reported to recycle at least once a day both at home and at school**.**

Low	Moderate	High
44%	58%	63%

Hypothesis Testing

Five research objectives were decided upon before the study began. Because of the nature of some data sets, formal hypotheses were not developed for all objectives.

In this section, all objectives will be discussed in terms of how successfully they were met. Then null hypotheses will be accepted or rejected for statistically appropriate data sets.

Objective 1

Look for similarities and differences in the composition of the waste stream, by volume that is disposed of in the school's solid waste containers at Robert E. Lee Elementary which has recycling services through the City of Denton, Ronald E. McNair which has access Abitibi paper recycling but does not participate, and Sam Houston Elementary which actively participates in Abitibi Recycling.

Results: There were differences between the waste streams generated by the three participating schools. Based upon the data collected, Robert E. Lee Elementary, which participated in the City of Denton School Recycling Program, was able to divert a greater percentage of recyclable material by volume from the landfill than Ronald E. McNair Elementary, which had access to but did not actively participate in recycling. Additionally, Lee Elementary was able to divert a greater portion of recyclable material by volume from the landfill than Sam Houston Elementary, which exhibited active participation in the Abitibi paper-recycling program.

Objective 2

Monitor the weight of solid waste and recyclables generated on average per person per day by the students, faculty and staff at Robert E. Lee Elementary before and after implementation of the recycling service and education program. The weight

data will be used to measure any difference, over time, in the generation of non-recyclable solid waste as well as to document the amount, by weight, of material diverted from the landfill through recycling.

Hypothesis 1: The mean weight of Solid Waste generation per person per day at Robert E. Lee Elementary was not significantly different before implementation of the City of Denton Recycling Program, than the mean weight of Solid Waste generation per person per day after implementation (α=0.05).

Results: The mean weight of solid waste per person per day at Robert E. Lee Elementary was not significantly different during the month before implementation of the school recycling program, February 2004, than the mean weight per person per day one month after implementation, April 2004, (independent t-test, p=0.82).

Objective 3

Compare the weight and volume of solid waste generated within an elementary school with City of Denton Recycling to that of a school with a high level of participation in Abitibi paper recycling as well as to that of a school with very low participation in the Abitibi paper-recycling program.

Hypothesis 2: The mean weight of solid waste produced per person, per day a school with City of Denton Recycling is not significantly different from the mean weight of solid waste produced per person per day the two study schools without City of Denton Recycling (α=0.05).

Results: The mean pounds of solid waste produced per person per day by students, faculty and staff at Robert E. Lee Elementary after implementation of the recycling education program through the City of Denton was not significantly different from that produced by the students, faculty and staff at either of the other two study

schools (Kruskall Wallis multi-sample analysis with x^2 approximation, 0.25 >p>0.10 [p=0.1732]).

Objective 4

Monitor curbside recycling participation within the Robert E. Lee Elementary attendance zone, before and after the implementation of the school recycling and education program in order to look for any differences in participation over time.

Results: There was an overall increase in the curbside recycling participation rate within the Lee Elementary attendance zone over the course of the study.

Objective 5

Design and conduct a survey to assess participants' knowledge about, attitudes toward, and behaviors regarding recycling at home and at school before and after implementation of educational programming. Look for differences between 3rd and 5th grade, as well as between male and female survey participants. Also, look for a correlation between survey participants' level of knowledge about recycling and their tendency to participate in pro-recycling behavior. Results will be presented for the pre-education survey and the post-education survey following each hypothesis.

Hypothesis 3: Students' level of knowledge regarding recycling is not contingent upon grade level (α=0.05).

Results:

- Pre-Education Survey – In a survey conducted before implementation of the recycling education program at Robert E. Lee Elementary, 3rd and 5th grade student

responses indicated that knowledge about recycling was not significantly contingent upon grade level (x^2 contingency test, p=0.7654) (See Appendix B, Table 22)

- Post-Education Survey – In a survey conducted upon completion of the recycling education program at Robert E. Lee Elementary, 3rd and 5th grade student responses indicated that knowledge about recycling was not significantly contingent upon grade level (x^2 contingency test, p=0.3213) (See Appendix B, Table 23).

Hypothesis 4: Students' level of knowledge regarding recycling is not contingent upon gender (α=0.05).

Results:

- Pre-Education Survey – Student responses to the survey conducted before the implementation of the recycling education program at Robert E. Lee Elementary showed that respondents' level of knowledge regarding recycling was not significantly contingent upon their gender (x^2 contingency test, p=0.2698) (See Appendix B, Table 24).

- Post-Education Survey – Student responses to the survey conducted upon completion of the recycling education program at Robert E. Lee Elementary showed that levels of knowledge regarding recycling was not significantly contingent upon gender (x^2 contingency test, p=0.3875) (See Appendix B, Table 25).

Hypothesis 5: Students' level of participation in pro-recycling behavior is not contingent upon gender (α=0.05).

Results:

- Pre-Education Survey – Bas*ed* upon responses to the survey conducted before implementation of the recycling education program at Robert E. Lee Elementary,

students level of participation in pro-recycling behavior was not contingent upon gender (x^2 contingency test, p=0.1687) (See Appendix B, Table 26).

- Post-Education Survey – Upon completion of the recycling education program, students' survey responses again showed that participation in pro-recycling behavior was not significantly contingent upon gender (x^2 contingency test, p=0.3072) (See Appendix B, Table 27).

Hypothesis 6: Students' level of participation in pro-recycling behavior is not contingent upon their level of knowledge about recycling.

Results:

- Pre-Education Survey – Before implementation of the recycling education program, surveyed students' levels of pro-recycling behavior were significantly contingent upon their knowledge about recycling (x^2 contingency test, p=0.0079) (See Appendix B, Table 28).

- Post-Education Survey – Upon completion of the recycling education program, surveyed students' levels of pro-recycling behavior no longer appeared to be significantly contingent upon their knowledge about recycling (x^2 contingency test, p=0.3072) (See Appendix B, Table 29).

CHAPTER IV

DISCUSSION AND RECOMMENDATIONS

Waste Characterization

The waste characterization data that was collected at the three study schools over the course of one week of each month for five months, revealed some interesting findings. For example, even though Lee Elementary was participating in the City of Denton recycling program and they were able to reduce the volume of their solid waste substantially, they were still producing more solid waste per person per week than either McNair or Sam Houston Elementary. When total waste generation, including recycling, was analyzed, it was determined that Lee Elementary actually generated more than twice as much waste as the other schools during the weeks that all three school waste streams were measured. Two possible explanations for this are as follows.

First, during the study period, Lee Elementary was being completely rebuilt. Although most construction waste went into commercial solid waste containers that the builders had contracted for service, all of the waste that was generated by moving into new classrooms went into the school's solid waste or recycling containers. All teachers moved from old to new classrooms in the fall 2004. Additionally, the school library was downsized into a portable building. As with any move, an enormous amount of material was purged from old classrooms, the library and administrative offices during this time.

The second possible explanation is related to food waste generation. Food waste was a very prevalent problem at Robert E. Lee Elementary. Teachers reported emphasizing repeatedly to the students, to take only what they could eat. Students were continually reprimanded for placing uneaten food, unopened milk cartons and juice

bottles into the trash. The daily food waste generated at Lee Elementary made up a substantial portion of their non-recyclable solid waste.

Lee Elementary had the greatest number of students that fall into the category of "economically disadvantaged" in the district. Among the study schools they also had the highest number of students taking advantage of the "Free and Reduced Meals Program" through the State of Texas (See Table 10) (TEA 2004). The National School Lunch Act, which was passed in 1946, established the National School Lunch Program (NSLP) in order to provide nutritionally balanced, low-cost or free lunches to students under the age of 18. The NSLP serves over 26 million children each school day. Students from families with incomes at or below 130% of the poverty level ($24,505 for the period between July 1, 2004 and June 30, 2005 for a family of four) are eligible for free meals and those from families between 130% and 185% ($24,000 to $34,000 annual family of four income) of the poverty level qualify for reduced-price meals which are not to exceed a cost of more than 40 cents. High numbers of students that qualify for free and reduced meals within a school, are a good indicator for the percentage of students within that school that are eating cafeteria prepared food for both breakfast and lunch (DISD 2004). The Lee Elementary cafeteria served at least 50% more of their student body population at breakfast and 14-15% more at lunch than the other two campuses individually (See Table 11). Although industrial sized steel cans as well as glass and plastic jars of fruits and vegetables are recyclable, no other trash generated during lunch and breakfast can be recycled. Economics could help to explain why students at Lee Elementary appear to be generating more trash even after implementation of the school recycling program than the other schools.

Table 10. Numbers and Percentages of students who qualify for free and reduced price meals among the three study schools.

Campus	Students Qualifying for Free and Reduced Price Meals	% of Student Body Qualifying
Lee	346	63%
McNair	87	13%
Houston	159	24%

Table 11. Daily average counts of breakfast and lunch meals served at the three study campuses. Also given, the average daily percentages of each campus' student body served.

Campus	Daily Average Breakfast Meals Served	Percentage of Student Body Served	Daily Average Lunch Meals Served	Percentage of Student Body Served
Lee	120.5	21.59%	387.2	69.39%
McNair	66.2	9.16%	401.1	55.48%
Houston	74.8	11.00%	367.8	54.09%

Waste Characterization

The amount of paper that was in the trash at the two comparison schools was staggering despite the fact that they both have Abitibi paper recycling dumpsters on campus. This implies that a large amount of the paper that is being placed in these recycling dumpsters is coming from the surrounding community rather than from within the school. Although it is good to see that the community is trying to help the school, it is also interesting to see that the school is not taking advantage of the opportunity to reduce their own waste as much as possible.

As a result of this study, it appears that having one person visiting a school and encouraging recycling efforts on campus makes an enormous difference in how much participation comes from within the school. Because Sam Houston has had so much financial success with the Abitibi program, it might not be possible to convince them to use another program. However, for the rest of the school district, educational and support components as well as the solid waste diversion and subsequent cost savings potential of recycling through the City of Denton's School Recycling Program should be very convincing.

Weight and Volume of Solid Waste Generation

With the opening of a new building at Robert E. Lee Elementary in the fall 2004, and all of the new desks, chairs and bookshelves that were unpacked, a substantial amount of corrugated cardboard waste was generated within a very short time-frame. Due to the City of Denton Recycling Division's involvement with Lee Elementary School the previous semester, the school's custodial staff was familiar with the City's recycling services and they expressed a desire to "keep (recyclables) out of the landfill." Upon their request, the Recycling Division was able to place two thirty cubic yard dumpsters for cardboard only at the school for three days. The containers were completely filled three times resulting in 9.54 tons of corrugated cardboard which was diverted from the landfill through recycling. Based on 2004 rates, disposing of this material in the local landfill would have cost the school district $950.55. The Recycling Division was able to recycle the same material at a customer cost of $450.

Additional cost savings were seen at Lee Elementary due to their ability to reduce the volume of solid waste they generated throughout the study. When the study began in February 2004, Lee Elementary was filling two-four cubic yard solid waste containers five days a week, which totals 40 cubic yards, generated per week at a cost of $674 per month. By the end of the study in December 2005, Lee Elementary required one-six cubic yard dumpster emptied three times a week and one-six cubic yard dumpster emptied once a week. Capacity-wise they only needed one six yard container, but because of the difficulty navigating during the construction of the new school buildings, we found it necessary to place one container near the cafeteria on top of hill, and one near the classrooms at the bottom of the hill.

The combined estimated cost of service at the end of the study was $515.18. After construction is completed at the school, I anticipate that one-six cubic yard container for solid waste and two-eight cubic yard containers for recycling will be adequate. The cost for this level of service should be less than $400 per month. At this level, the school district could save at least $3,288 annually on solid waste services at Lee Elementary alone.

After implementation of the in-school recycling program, the students, teachers and staff at Robert E. Lee Elementary were able to divert a weekly average of 24.14%, by weight, of their solid waste from the landfill through recycling. Additionally, as a result of their diversion efforts, they were able to reduce the volume of required solid waste service from forty cubic yards per week down to twenty-four cubic yards per week. This constitutes a 40% reduction in the required level of solid waste service and approximately a $100 per month cost savings for that campus. If the entire school

district was able to achieve at least a 40% reduction in the volume of solid waste that they generate, at the recycling and solid waste fee schedule current as of April 2005, they could substantially reduce their annual solid waste fees as well. Due to the confidentiality of customer account records, exact cost savings potential for the entire district will not be shown.

In anticipation of expanding the school recycling program to other local campuses, it is important to not loose sight of the environmental impact of recycling. Because of past precedents, it will be difficult to shift the focus on recycling from how much money a school can make and/or save, to what a difference, environmentally speaking, is possible through recycling at school. Although money motivates many people, children seem to genuinely care about protecting the earth and its natural resources. As the program proceeds, it will be important to show schools how handling the waste differently, can result in a significant cost savings for the school district, while carefully avoiding the potential to perpetuate the “What’s in it for me?” phenomenon.

Ideally, schools will choose to recycle because it is the environmentally responsible thing to do. This touches on a possible explanation for why the Abitibi program has not been successful at diverting paper from within the schools over the long run. Schools have been focused on how much paper they could get in their paper recycling dumpster so that they would get a check rather than focusing on reducing the amount of waste they generate in order to reduce our consumption of natural resources, protect habitats, and reduce our reliance on foreign sources. Currently, no one is in the local schools consistently telling students and teachers how important it is to recycle

and showing them what a difference they are making when they reduce the amount of waste they generate.

Curbside Recycling Participation

Although it is impossible to isolate all factors that may have had an influence on the number of families that chose to recycle any given week, the curbside recycling participation rates throughout the study illustrate an increase in recycling rates over the first few months of the study while students were still in school during the spring 2004. A dramatic decrease in participation during the summer months, when the students were not in school was observed, and then once again when school resumed in the fall 2004, a marked increase in curbside recycling participation rates was seen throughout the semester.

It is very difficult to determine all of the variables that may have had an affect on curbside recycling participation throughout the study, but the data seem to suggest that homeowners were recycling with higher frequency during the months that students were in school, than they were during the summer months while students were not exposed to recycling education. On the surface, this indicates that the school programming was making a difference at home, but truthfully, there are other possibilities for the lack of participation during the summer. There was considerable difficulty with the quality of service through Trinity Waste Services, the recycling company that is contracted through the City of Denton to handle residential curbside recycling, during the summer 2004. Several neighborhoods within the city were repeatedly missed on regularly scheduled pickup days and the recycling program received quite a bit of “bad press.”

Due to a high volume of complaints, it is not out of the realm of possibility that this had an effect on curbside recycling participation.

Knowledge, Behavior and Attitudes Survey

Although the survey should have been conducted at the very beginning of the fall semester (August or September) the process for receiving approval from the IRB to conduct research on human subjects took much longer than expected. This will be taken into consideration in the case of any future studies involving human subjects and the University.

Additionally, the difficulty in getting the survey assent forms signed by parents and returned to the school presents an opportunity for future improvement. Overcoming the Spanish/English language barrier may have led to parents returning more assent forms earlier. In the future working closely with a translator on materials that will go into the local schools would be advisable. Even for those parents who read English, the forms may have been intimidating. Designing a less clinical sounding assent form would also be important for future studies involving students.

Given the opportunity to rewrite the survey some different questions would be included, and several questions would be worded differently. For example, it would be helpful to know how many of the survey participants live in multi-family versus single-family homes. The attempt to ascertain this by asking if students had a blue recycling cart at home was not effective. Although all of the students responded to this question, most reported having a blue recycling cart at home. It does not seem possible to almost all of the survey participants live in single-family houses, considering the economic

status of the community. It is possible that they lacked a true understanding of the question, or that they perceived a possibility of being excluded if they responded that they did not have a blue cart at home, which drove them to be less than honest. Although a City official advised against asking directly for student's housing situation, it would be helpful to find a way to better way to ascertain the true access to curbside recycling among survey participants.

It would also be helpful to know more about students' attitudes toward environmental issues such as recycling. Although students were asked to choose a word to describe people who recycle, it was difficult to determine what students actually thought, rather than what they thought they were supposed to say.

CHAPTER V

CONCLUSIONS

An essential component of making a recycling program work within a school is having someone that is easily accessible to keep students, teachers, and administrators excited about the program and to provide training and support for the custodial staff and teachers. The success of the program depends heavily upon the ability to conquer old habits and change the way that people think about the manufacturing, use and disposal of goods. As is illustrated by the waste characterization, a comprehensive in-school recycling program can make a difference in the type and amount of waste that schools send to the landfill.

As schools begin to see the value in recycling and choose to participate, they will reap both the short and long-term rewards. The financial savings that result from recycling are immediately apparent and will make a substantial difference for schools that are struggling to squeeze the last drop from their annual budgets. There are better uses for school funding than paying to store trash in a landfill. In the long-term, helping students form the habits of sustainable behavior, will serve all of Earth's inhabitants for generations to come.

Life skills learned at school undoubtedly influence student's behavior at home. Although this study could not find a direct correlation between recycling at school and recycling at home, on several occasions during the study, teachers reported that parents called the school looking for information on recycling because their child came home wanting to use the blue recycling cart. This illustrates the opportunity and

obligation that educators have to impart the habits of sustainable behavior upon students and ultimately the greater community.

In both of the surveys conducted at Robert E. Lee Elementary, the majority of students indicated that they perceive people who recycle in a positive way. Survey responses also showed that students were reluctant to admit that their families did not recycle at home. Herein lies evidence that there is a great opportunity to educate young people about how to turn the good feelings they have regarding what others are doing, into their own abilities to take action. Based upon the finding in the first survey that students were more likely to recycle if they knew what could be recycled, it appears that by increasing students' knowledge and awareness about recycling it will be possible to increase recycling behavior over time.

It is evident that future recycling education within schools will need to be directed toward all students regardless of age or gender. Although the City of Denton Recycling Division mascot, "Recyclesaurus Rex," was very appealing to kindergarten through 2nd grade students, it will be important to design future promotions using styles and images that appeal to older students. For example, 3rd through 5th graders might be more influenced by a campaign that uses images of kids skateboarding or dancing rather than a big green dinosaur. Likewise a campaign targeted toward middle or high school students should be much different than a campaign for five to seven year old students, because the images that are relevant and appealing to these age groups are very different.

This study is among the many exciting and progressive environmental programs currently being undertaken within the City of Denton, Texas. With two public universities

and a well educated and active populace, Denton serves as a great example to other communities about how to live, work, learn and play while always exploring ways to lessen our environmental impact and conserve natural resources for future generations.

APPENDIX A

RAW DATA

Table 12. Waste characterization conducted at Lee, McNair, and Houston elementary schools the week of December 13-17, 2004

Campus	Date	Volume	Percentages of					Notes
			Paper	Cardboard	Co-mingle	Organic	Trash	
Lee	12/13	5	2	0	1	30	67	Primarily lunch trays, paper towels, and food waste.
	12/14	4.5	2	2	5	30	61	Primarily lunch trays, paper towels, and food waste.
	12/15	4	5	0	1	25	69	Primarily lunch trays, paper towels, and food waste.
	12/16	4.5	10	5	5	20	60	Primarily lunch trays, paper towels, and food waste.
	12/17	5	2	0	1	30	67	Primarily lunch trays, paper towels, and food waste.
	Means	4.6	4	1	3	27	65	
McNair	12/13	6	30	10	10	40	10	A lot of residential trash in the containers.
	12/14	6	40	0	20	20	10	Lunch trays are emptied & stacked substantially reducing vol.
	12/15	7	50	2	5	27	15	Lunch trays are emptied & stacked substantially reducing vol.
	12/16	8	.3	5	10	40	20	6 bags of Yard Waste
	12/17	11	60	5	10	20	15	Christmas Party Trash, all containers full
	Means	7.6	41	4	11	29	14	
Houston	12/13	9	20	10	10	20	40	Lunch trays not stacked or bagged, using substantial amt of vol.
	12/14	7	20	10	10	20	50	Approximately 1/2 vol. = non-stacked non-bagged lunch trays.
	12/15	7	15	5	10	20	50	Approximately 1/2 vol. = non-stacked non-bagged lunch trays.
	12/16	8	20	5	5	20	50	Approximately 1/2 vol. = non-stacked non-bagged lunch trays.
	12/17	8	20	5	5	20	50	Approximately 1/2 vol. = non-stacked non-bagged lunch trays.
	Means	7.8	19	7	8	20	48	

Table 13. Robert E. Lee Elementary School waste generation and diversion rates during the study period of February 2, 2004 thru December 13, 2004.

Week of	Total Volume Serviced	Lbs School Waste Generation By Week *	Lbs Waste Generation Per Person Per Day	% Weekly Diversion Through Recycling
Feb 2	48	3540	1.1722	No diversion during the first month of the study
Feb 9	52	3900	1.2914	
Feb 16	48	3200	1.0596	
Feb 23	36	2640	1.4570	
Mar 1	40	3580	1.1854	24.02%
Mar 8	40	3100	1.0265	17.42%
** Mar 15	40	1360	0.4503	32.35%
Mar 22	40	2600	0.8609	16.15%
Mar 29	40	3100	1.0265	14.19%
Apr 5	40	2860	1.1838	11.89%
Apr 12	44	2180	0.9023	20.18%
Apr 19	54	4140	1.3709	14.98%
Apr 26	32	3000	0.9934	0.00%***
May 3	56	5600	1.8543	36.43%
May 10	46	5840	1.9338	42.81%
May 17	46	6600	2.1854	45.45%
May 24	62	7580	2.5099	49.87%
Aug 23	70	6300	1.9749	19.68%
Aug 30	102	7420	2.3260	10.78%
Sept 6	48	2220	0.8699	19.82%
Sept 13	96	5780	1.8119	9.69%
Sept 20	94	3160	0.9906	17.72%
Sept 27	76	3600	1.1285	30.00%
Oct 4	66	3420	1.0721	21.05%
Oct 11	72	2720	0.8527	35.29%
Oct 18	46	2900	0.9091	17.24%
Oct 25	30	2980	0.9342	15.44%
Nov 1	46	3440	1.0784	22.09%
Nov 8	46	2940	0.9216	14.29%
Nov 15	40	3220	1.0094	14.29%
Nov 22	42	2620	2.0533	21.37%
Nov 29	40	2560	0.8025	11.72%
Dec 6	34	2880	0.9028	9.72%
Dec 13	40	3300	1.0345	18.18%
Averages****	52	3767	1.2719	21.14%

*Waste Generation = Trash and Recyclables **Week of Spring Break, no classes. ***No recycling picked up this week ****After implementation of the in-school recycling program

Table 14. Monthly recycling totals by weight and by weight per person at Lee Elementary, McNair, and Houston Elementary.

Month of	Lee	Pounds Per Person	McNair	Pounds Per Person	Houston	Pounds Per Person
Feb-04	2500	3.92	2240	2.79	9000	11.92
Mar-04	2700	4.23	2860	3.56	14000	18.54
Apr-04	1400	2.19	3400	4.23	10280	13.62
May-04	11320	17.74	899	1.12	896	1.19
Aug-04	2040	3.20	2880	3.59	15620	20.69
Sep-04	2640	4.14	3140	3.91	13520	17.91
Oct-04	2640	4.14	5260	6.55	11540	15.28
Nov-04	2500	3.92	514	0.64	1003	1.33
Dec-04	880	1.38	521	0.65	1061	1.41

Table 15.Count of homes participating in curbside recycling within the Lee Elementary Attendance Zone by date counted. Calculated participation rates by date are listed at the bottom of the table.

Street Name	# of Houses on Street	11/13/03	11/20/03	01/15/04	02/26/04	03/25/04	04/29/04	05/27/04	07/29/04	09/30/04	10/28/04	12/09/04
Hettie	41	10	10	11	10	12	13	11	6	12	10	10
Janine	31	15	16	13	8	17	15	13	11	15	16	16
Davis	0	2	3	0	0	3	3	4	3	3	2	1
Noble	14	3	4	1	4	3	4	4	3	4	3	
Woodford	22	8	15	13	5	10	10	11	10	10	7	11
Charles	4	2	3	0	1	1	2	3	3	4	3	3
Mack	78	26	25	22	29	35	24	28	26	26	27	26
Bull Run	20	6	8	6	8	9	5	6	4	4	5	7
Lee	25	7	11	9	8	8	4	6	4	9	8	7
Summerwind	6	1	1	3	3	2	3	2	2	3	9	2
Fox Creek	14	7	6	11	9	6	8	9	5	6	5	8
Eagle Nest	6	3	4	0	3	3	4	3	3	2	3	3
Double Oak	12	6	8	4	7	8	10	7	12	7	6	7
Longmeadow	34	17	16	21	17	17	16	12	12	18	16	15
Bellaire	45	20	14	19	16	14	14	18	18	21	5	24
Montclair	14	7	7	6	6	6	10	8	5	6	3	7
Bluebird	31	13	12	11	8	10	12	15	8	12	14	16
Hummingbird	38	14	13	5	8	7	13	6	9	7	10	11
Bob-o-link	54	20	20	21	8	18		18	11	16	18	12
Cardinal	5	0	1	1	2	0	0	1	0	1	3	2
Oriole	34	9	9	10	11	11	16	17	11	10	12	11
Kingfisher	38	17	18	18	10	11	19	17	11	8	16	16
Meadowlark	28	10	11	17	8	12	10	12	9	9	13	14
Weston	25	8	6	3	6	6	12	7	5	5	9	9
Pace	37	20	18	23	11	6	19	19	5	17	20	15
Joshua	32	12	9	12	7	8	10	9	4	9	11	15
Paisley	59	24	25	15	16	17	8	11	9	9	21	16

(table continues)

Table 15 (continued).

Street Name	# of Houses on Street	11/13/03	11/20/03	01/15/04	02/26/04	03/25/04	04/29/04	05/27/04	07/29/04	09/30/04	10/28/04	12/09/04
Christopher	17	12	12	12	10	11	8	12	5	8	4	13
Penniman	24	9	7	10	2	8	6	9	6	8	9	10
Newport	33	9	8	10	6	8	7	7	5	11	11	14
Howard	26	11	8	0	4	9	9	9	7	8	12	9
Anysa	25	8	7	6	8	8	9	7	4	10	8	9

(table continues)

Beverly	20	7	8	8	5	7	8	3	6	7	8	7
Terry	21	9	12	8	10	8	8	8	5	10	7	8
Bayfield	41	20	18	20	22	14	20	23	16	22	20	17
Brittany	45	20	14	22	17	19	13	21	13	14	15	15
Woodthrush	26	14	13	14	10	8	13	16	7	12	11	15
Woodson	6	2	3	0	2	3	0	2	1	3	2	3
Conditt	6	1	1	2	1	4	0	3	1	1	3	4
Meng	6	2	3	2	1	2	3	14	1	3	2	3
Barnes	24	11	11	14	7	10	13	11	6	10	11	11
Indigo Terrace	4	2		2	2	3	2	2	2	4	4	2
Diane	7	3	4	5	5	5	5	5	1	4	4	4
Autumn Oak	28	11	9	12	10	11	16	14	9	8	12	10
Boyd	19	4	4	4	2	3	3	5	2	2	7	3
Brock	8	6	5	0	0	7	0	6	3	6	4	5
Campbell	50	26	27	29	23	28	24	22	6	2	25	24
Henderson	7	2	2	5	2	2	3	4	1	4	4	4
Lattimore	42	21	14	18	5	10	17	9	15	13	13	16
May East		5	3	3	9	6	5	4	2	9	9	4
May West	28	3	3	14	8	4	4	6	1	3	2	7
Meadow Oak	23	7	7	7	6	6	13	5	6	5	6	7
Mulkey/Mozingo		20	21	14	17	20	26	20	12	23	22	17

(table continues)

Table 15 (continued).

Street Name	# of Houses on Street	11/13/03	11/20/03	01/15/04	02/26/04	03/25/04	04/29/04	05/27/04	07/29/04	09/30/04	10/28/04	12/09/04
Paco	44	23	19	17	17	13	18	15	15	15	15	19
Pertain	2	2	1	0	0	0	0	0	0	2	1	2
Pinckney	8	5	5	5	4	5	15	6	4	3	3	2
Pin Oak	20	5	4	4	4	3	3	3	4	2	0	5
Rose	12	5	4	5	3	5	6	5	4	5	5	6
Royal Meadows	12	1	4	0	0	5	0	3	0	7	9	6
Ruddell	69	23	26	21	27	24	28	22	20	28	29	27
Snyder	13	3	4	0	4	4	4	3	0	5	5	5
Tyler	17	4	6	6	6	5	6	6	0	5	6	7
Wayne	32	6	8	5	0	6	7	4	0	7	9	6
White Oak	22	7	7	5	7	0	10	10	10	8	6	6
Wood	23	10	10	10	12	11	10	11	11	9	8	6
Mockingbird	34	1	7	7	10	10	5	7	7	9	9	11
Oakshire	20	14	11	11	8	10	13	11	9	9	8	11
Brandywine	28	10	10	13	10	11	9	13	6	14	9	12
Misty Hollow	13	3	1	3	3	3	4	3	0	3	4	5
Briarwood	12	4	2	4	4	3	4	4	2	3	4	4
Copper Ridge	14	4	4	5	6	4	5	5	7	7	4	4
Oak Tree	59	22	25	26	24	10	27	27	12	8	27	21
Whispering Oak	29	8	7	13	9	13	14	9	8	11	9	11
Oak Park	29	10	11	13	9	15	12	21	9	6	5	6
Oak Valley	12	6	8	8	7	6	7	9	8	11	7	8
Audra	48	12	11	13	8	11	6	4	2	8	20	17
Blackford Oaks	5	0	4	4	2	3	1	4	1	2	3	2
Allise	7	0	3	0	2	3	2	1	1	1	1	1
Timber Trail	23	0	0	15	7	10	7	9	9	11	9	14
Totals	1890	72 0	71 9	72 9	61 6	67 7	72 2	73 9	50 1	66 2	72 5	74 9
Participation Rate	100%	38.10%	38.04%	38.57%	32.59%	35.82%	38.20%	39.10%	26.51%	35.03%	38.36%	39.63%

APPENDIX B

RECYCLING SURVEY AND RESULTS RAW DATA

Recycling Survey

Note: Survey has been modified in format and presentation.

Demographic Assessment:

1. Please Circle One:
   I am a teacher
   I am a student

2. Please Circle One: Male Female

Behavioral and Attitude Assessment:

3. Fill in the blank:
   I think that people who recycle are _____.

4. Does your family have a blue recycling cart at home? Yes No I don't know

5. If you have a blue recycling cart at home, how often do you use it for recycling?
   Once a week Once a day Several times a day Never

6. How often do you put things that can be recycled into the recycling bin at school?
   Once a week Once a day Several times a day Never

7. If your family recycles at home, which person makes sure that things get recycled?

Mom	Grandma	Sister
Dad	Grandpa	Brother
Friend	Aunt	Other _____
Me	Uncle	

8. If your class recycles at school, who makes sure that you recycle everything that you can?
   We don't recycle at school.
   My Teacher
   The Students
   Other_____

9. If you do recycle at home, why do you do it?

I don't have anything at home that can be recycled.

My parents make me recycle.

I think it is fun and easy to recycle.

Recycling is good for the environment.

Other_____

10. If your family has a blue cart, but you do not recycle at home, why not?

The recycling cart is too far away.

I think recycling is a waste of time.

My family uses our recycling cart for things other than recycling.

Other_____

11. If you don't have a blue recycling cart at home, does your family save their recyclable things and take them to one of the City's recycling dumpsters?

Yes No I don't know

Knowledge Assessment:

12. If you have a blue cart at home, which of the following items can be recycled?

Glass bottles	Paper that has been written on	Cereal boxes
Plastic jars	Newspapers	Junk mail
Soda cans	Plastic bags	Juice boxes
Gum	Vegetable cans	Paper towels

When you are at school which of the following items can be recycled?

Glass bottles	Paper that has been written on	Gum
Plastic jars	Newspapers	Old books
Soda cans	Plastic bags	Juice boxes
Cardboard boxes	Tissues	Paper towels

Table 16. Survey 1: Levels of recycling knowledge and pro-recycling behavior among all survey participants. Results are shown by frequency and by percentage of total participants (*N*=81 Participants).

		Levels of Recycling Knowledge among All Survey Participants (correctly answered questions)			
		Low (<50%)	Moderate (50-69%)	High (70-100%)	Totals
Levels of Pro-Recycling Behavior Among All Survey Participants	Low	0	10	3	13
		0%	12%	4%	16%
	Moderate	3	10	5	18
		4%	12%	6%	22%
	High	2	20	28	50
		2%	25%	35%	62%
	Totals	5	40	36	81
		6%	49%	44%	100%

Table 17. Survey 2: Levels of recycling knowledge and pro-recycling behavior among all survey participants. Results are shown by frequency and by percentage of total participants (*N*=81 Participants).

		Levels of Recycling Knowledge among All Survey Participants (correctly answered questions)			
		Low (<50%)	Moderate (50-69%)	High (70-100%)	Totals
Levels of Pro-Recycling Behavior Among All Survey Participants	Low	3	8	5	16
		4%	10%	6%	21%
	Moderate	2	7	13	22
		3%	9%	17%	29%
	High	4	21	14	39
		5%	27%	18%	51%
	Totals	9	36	32	77
		12%	47%	42%	100%

Table 18. Survey 1: Levels of recycling knowledge and pro-recycling behavior among 3rd grade survey participants. Results are shown by frequency and by percentage of all 3rd graders surveyed (3rd graders surveyed *N*=42).

		Levels of Recycling Knowledge among 3rd Grade Survey Participants (correctly answered questions)			
		Low (<50%)	Moderate (50-69%)	High (70-100%)	Totals
Levels of Pro-Recycling Behavior Among 3rd Grade Survey Participants	Low	0 0%	8 19%	3 5%	10 24%
	Moderate	2 5%	4 10%	4 10%	10 24%
	High	0 0%	10 24%	12 29%	22 52%
	Totals	2 5%	25 52%	15 43%	42 100%

Table 19. Survey 2: Levels of recycling knowledge and pro-recycling behavior among 3rd grade survey participants. Results are shown by frequency and by percentage of all 3rd grade participants. (3rd graders surveyed *N*=34).

		Levels of Recycling Knowledge among 3rd Grade Survey Participants (correctly answered questions)			
		Low (<50%)	Moderate (50-69%)	High (70-100%)	Totals
Levels of Pro-Recycling Behavior Among 3rd Grade Survey Participants	Low	1 3%	3 9%	2 6%	6 18%
	Moderate	0 0%	4 12%	5 15%	9 26%
	High	2 6%	12 35%	5 15%	19 56%
	Totals	3 9%	19 56%	12 35%	34 100%

Table 20. Survey 1: Levels of recycling knowledge and pro-recycling behavior among 5th grade survey participants. Results are shown by frequency and by percentage of all 5th grade participants. (5th graders surveyed *N*=39).

		Levels of Recycling Knowledge among 5th Grade Survey Participants (correctly answered questions)			
		Low (<50%)	Moderate (50-69%)	High (70-100%)	Totals
Levels of Pro-Recycling Behavior Among 5th Grade Survey Participants	Low	10 0%	2 5%	1 3%	13 8%
	Moderate	1 3%	6 15%	1 3%	8 21%
	High	2 5%	10 26%	16 41%	28 72%
	Totals	14 8%	18 46%	18 46%	39 100%

Table 21. Survey 2: Levels of recycling knowledge and pro-recycling behavior among 5th grade survey participants. Results are shown by frequency and by percentage of all 5th grade participants. (5th graders surveyed *N*=43).

		Levels of Recycling Knowledge among 5th Grade Survey Participants (correctly answered questions)			
		Low (<50%)	Moderate (50-69%)	High (70-100%)	Totals
Levels of Pro-Recycling Behavior Among 5th Grade Survey Participants	Low	1 3%	3 9%	2 6%	6 18%
	Moderate	0 0%	5 12%	5 15%	9 26%
	High	2 6%	12 35%	5 15%	19 56%
	Totals	3 9%	19 56%	12 35%	34 100%

Table 22. Survey 1: x^2 Table of knowledge as it relates to grade level.

		Levels of Knowledge Among Survey Participants		
		Low-Moderate (>69%)	High (70-100%)	Totals
Grade Level	3rd	24 29.63%	18 22.22%	42 51.85%
	5th	21 25.93%	18 22.22%	39 48.15%
	Totals	45 55.56%	36 44.44%	81 100%

Table 23. Survey 2: x^2Table of knowledge as it relates to grade level.

		Levels of Knowledge Among Survey Participants		
		Low-Moderate (>69%)	High (70-100%)	Totals
Grade Level	3rd	22 28.57%	12 15.58%	34 44.16%
	5th	23 29.87%	20 25.97%	43 55.84%
	Totals	45 58.44%	32 41.56%	77 100%

Table 24. Survey 1: x^2 Table of knowledge as it relates to gender.

		Levels of Knowledge Among Survey Participants		
		Low-Moderate (>69%)	High (70-100%)	Totals
Gender	Females	17 20.99%	18 22.22%	35 43.21%
	Males	28 34.57%	18 22.22%	46 56.79%
	Totals	45 55.56%	36 44.44%	81 100%

Table 25. Survey 2: x^2 Table of knowledge as it relates to gender

		Levels of Knowledge Among Survey Participants		
		Low-Moderate (>69%)	High (70-100%)	Totals
Gender	Females	17 20.08%	16 20.78%	33 42.86%
	Males	27 35.06%	17 22.08%	44 57.14%
	Totals	44 57.14%	33 42.86%	77 100%

Table 26. Survey 1: x^2 Table of pro-recycling behavior as it relates to gender.

		Levels of Knowledge Among Survey Participants		
		Low-Moderate (>69%)	High (70-100%)	Totals
Gender	Females	10 12.35%	25 30.86%	35 43.21%
	Males	20 24.69%	26 32.10%	46 56.79%
	Totals	30 37.04%	51 62.96%	81 100%

Table 27. Survey 2: x^2 Table of pro-recycling behavior as it relates to gender.

		Levels of Knowledge Among Survey Participants		
		Low-Moderate (>69%)	High (70-100%)	Totals
Gender	Females	15 19.48%	18 23.38%	33 42.86%
	Males	24 31.17%	20 25.97%	44 57.14%
	Totals	39 50.65%	38 49.35%	77 100%

Table 28. Survey 1: x^2 Table of behavior as it relates to knowledge

		Levels of Knowledge Among Survey Participants		
		Low-Moderate (>69%)	High (70-100%)	Totals
Levels of Pro-Recycling Behavior	Low-Moderate	23 28.40%	8 9.88%	31 38.27%
	High	22 27.16%	28 34.57%	50 61.73%
	Totals	45 56.56%	36 44.44%	81 100%

Table 29. Survey 2: x^2 Table of behavior as it relates to knowledge.

		Levels of Knowledge Among Survey Participants		
		Low-Moderate (>69%)	High (70-100%)	Totals
Levels of Pro-Recycling Behavior	Low-Moderate	20 32.47%	18 23.38%	38 49.35%
	High	25 32.47%	14 18.18%	39 50.65%

APPENDIX C

IN-SCHOOL RECYCLING PROMOTION

Figure 15. Recycling Center located in the lower level hallway of Robert E. Lee Elementary School.

Figure 16. Prizewinning 4th grade classroom recycling center, set up by students during the "Recycling Station Creation Contest."

1527 S. Mayhill Road
Denton, TX 76208

September 23, 2004

Robert E. Lee Elementary
800 Mack Place
Denton, TX 76209-6314

Subject: Recycling Program and Contest

Dear Robert E. Lee Elementary Teachers,

The Lee Elementary recycling pilot program is off and running again this year, and we need to get the students more involved. With that intent, the City of Denton is holding a school-wide contest. All participating classes are asked to design and implement a recycling station within their classroom following the attached guidelines. In order to increase the investment of the students, as well as ease the burden on the hard working Lee Elementary custodial staff, the students need to take over of moving recyclables from your classrooms to the recycling centers located throughout the school even if your class chooses not to participate in the contest. Sometimes recycling requires a little more effort from everybody than just throwing things away, but the rewards of conserving our natural resources, not to mention the cost savings of reducing solid waste, are well worth it.

As the second six weeks quickly approaches, please remember that I am always available to visit your classroom with hands on recycling and resource conservation activities. All of my activities align with the science TEKS as well as the DISD Science Scope and Sequence. Both 2nd and 4th grades have natural resource conservation science units coming up this six weeks. Please contact me to schedule a visit at your earliest convenience.

I am working with the Lee Elementary PTA to promote environmental awareness at Lee Elementary. Additionally, Mr. Moseley and I are trying to put together a student environmental club and a composting program. If you have any interest in participating in these efforts, please jump in! We would love to have any type of support you can provide.

I am never more than a phone call or e-mail away, so please contact me anytime. (Even if you just have a question about recycling!)

F.Y.I. Last semester, just by recycling at school, you and your students reduced the solid waste going to the landfill from Lee Elementary by 25%! GREAT JOB!

Thanks for all you do!

-Carey a.k.a. “The Recycling Lady”

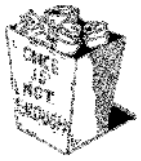
Carey Cunningham-Scott
Recycling Education Coordinator
Solid Waste Department Denton Municipal Utilities
Phone (940) 349-8064
Fax (940) 349-8057
carey.cunningham-scott@cityofdenton.com

CONTEST GUIDELINES ARE ON THE OTHER SIDE OF THIS LETTER!

Panther's Recycling Station Creation Contest

The City of Denton Recycling Staff will judge the contest after school, on Thursday October 7, 2004. 1st, 2nd, and 3rd place winners will be announced and Recyclesaurus Rex will present class awards on Friday October 8, 2004 between 2:00 and 2:45 pm. Teachers of selected classes will be notified Friday morning.

Contest Rules:

- All participating classrooms must register in order to be entered in the contest. Register by e-mailing Carey, *a.k.a. The Recycling Lady,* (carey.cunningham-scott@cityofdenton.com) with the following information, before 5:00  dnesday October 6, 2004:

  1. Teacher Name
  2. Grade
  3. Room #

- Recycling station must accommodate three small clearly marked separate containers for:

  1. Paper
  2. Co-mingled Recyclables
  3. Trash (Only for things that cannot be recycled or reused.)

- Only reused or recycled materials should be used in the design of the recycling station. Do not purchase new materials for this station! Students can create and decorate recycling containers made from cardboard boxes, old trash-cans, used buckets, baskets, etc…

- A rotating **student recycling leader schedule** must be posted within the station. The scheduled student leader will be in charge of making sure recyclables are removed from the classroom regularly and taken to one of the recycling centers within the school.

Recycling stations will be judged based upon the following:

Creative Reuse of Materials	1-10 points
Creative Design of Station	1-10 points
Following Guidelines	1-10 points
Posted Schedule	1-10 points
Efficient use of Space	1-10 points

*Up to 5 **Bonus Points** will be offered for a clearly marked reuse area where used paper, pencils, notebooks, binders etc. can be placed for others to re-use.

Denton Recycles

Attention:
Robert E. Lee Elementary is hereby challenged to create the awesome recycled holiday ornaments that will decorate the City of Denton Recycling Department's Holiday Tree for the December 2nd, Holiday Lighting Festival on the Square.

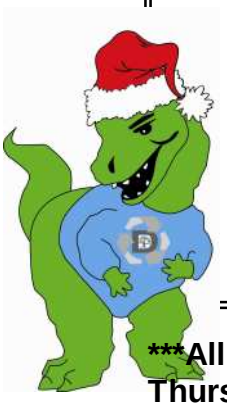
Show off your class's incredible abilities to think creatively by making a holiday ornament from reused materials. The ornaments Lee Elementary classes create will decorate the Recycling Division's Holiday Tree on the square during the Tree Lighting Festival. *If your family would like to attend the festival, admission is FREE and it starts at 5:30 p.m. Santa and Recyclesaurus Rex will be there along with Denton's own Brave Combo and lots and lots of other Denton families!*

After the Festival, the Recycling Tree will go to Denton City Hall East the whole month of December 2004. (That's where residents pay their utility bills and lots of people will see your class ornament!)

Only Lee Elementary is invited to create these special ornaments, so the tree will be bare without your help. All classes are encouraged to be involved and all winter holiday themes are welcome.

(One ornament per class please!)

Recyclesaurus Rex asks that you please follow these guidelines:



1. The ornament should be made of re-used items, such as soda bottles, CD's, floppy disks, old fabric, newspaper, etc. (New glue, paint, and glitter are allowed!)
2. The ornament can be no larger than 10 inches X 10 inches. Smaller is okay!
3. Please attach a note card with your grade and teacher's name to your ornament. You can also list the materials your class used if you like!

*****All ornaments** *MUST* **be given to Carey "The Recycling Lady" by 12:00 p.m. Thursday, December 2, 2004 to be shown at the Tree lighting that evening.** To have your ornament picked up; contact Carey by E-mailing to *carey.cunningham-scott@cityofdenton.com* or by calling (940) 349-8064.

YEP, THAT MEANS YOU HAVE FOUR (4) CLASS DAYS TO COMPLETE THIS!
Ornaments will be returned to each participating class after the winter break.

Denton Recycles

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