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A Trash-Free Lunch Experiment: Measuring "Before" and "After"

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Introduction

Global warming. Energy crisis. Deforestation. If you only watch television news, you might believe that Earth's environmental problems are so huge that they cannot be solved. But we don't believe that at all. Humans, through their ingenuity and industry, have invented technologies and engaged in behaviors that pollute, and now we are challenged to create new technologies and new ways of behaving that conserve resources while at the same time meeting our basic needs.

Last year, students at Taylor Elementary School in Arlington, Virginia, participated in an experiment to see whether they had the power to change their behavior—individually and collectively—and thus have a measurable, positive effect toward solving an environmental problem. The project was inspired by the "Pack a Waste-Free Lunch" poster by the U.S. Environmental Protection Agency (EPA) and the "Trash Audits" activity by Waste Free Lunches.org.[1] When planning the project, we referred to content standards for social studies, science, health, and math.

Overview

The experiment takes place over the course of three weeks. To kick off the project, parent volunteers secretly weigh the trash produced by each grade during lunch period. The following week, teachers describe the project and provide a chart showing the weight measurements of the lunch trash produced by each grade. Students discuss problems associated with solid waste and work with the numerical data to better understand the scale of what is happening. They discuss possible solutions to the problems.

Then students immediately set to work on implementing a real-world solution: reducing their own school lunch waste. They learn how to pack a waste-free lunch by using reusable containers and utensils, recycling any eligible material, and composting raw fruit and veggie leftovers from lunch. Students who buy the school lunch are encouraged to take only the food that they actually intend to eat and to compost their raw fruits and vegetables as well. Students are encouraged to stock up at home on the reusable items (like sandwich containers) needed to pack a waste-free lunch.

During the final week, students do their best to apply what they have learned during their "Waste-Free Lunch Week." The Thursday of that week, parents weigh each grade's waste again after lunch but this time students know what is going on, and they have tried to reduce their trash flow.

On Friday, the students are given the "after waste-reduction" data for comparison with the "before" data. Students in older grades calculate the annual per student lunch waste. Students in each grade discuss the results and can celebrate their efforts to change their behavior and help the planet.

In sum, students can then see for themselves that individual behaviors, added together, can create a big problem. But it is also true that small changes in personal behavior, like packing a waste-free lunch, can make a big difference in solving a community problem. In this case, we can reduce the community's waste stream and improve our environment.

Learning Objectives

During the Waste Free Lunch Experiment, students will

- learn about their individual and collective impact on the environment,
- study numerical data (collected on a single day) and perform some basic calculations to predict long-term results,
- deliberate over possible sustainable solutions to the problem at hand, and finally
- implement solutions, compare the resulting numerical data, and reflect on the whole activity.

This project aligns with content standards for social studies as well as for health, science, and math.[2]

Materials

A bulletin board should be devoted to displaying the first three items listed here as well as the data chart with measurements of lunch waste.

- EPA poster and classroom activity booklet (see note 1)
- handout (information flier)
- samples of waste-free lunch equipment (and disposable items for contrast)

Figure 1. **Lunch Trash Measured Before Waste Reduction**

On Friday, parents weighed the amount of material each grade threw away as lunch waste. The second column shows the measurements (the raw data) from that day, November 30, 2007.

Grade	Amount of Waste (LBS)	Number of Students	LBS per student per Year
K -	24	105	41
1st -	28	94	54
2nd -	29	89	59
3rd -	22	91	44
4th -	35	114	55
5th -	38	94	73
Total	**176**	**587**	

What is the total lunch waste for this day? (Adding the amounts gives us 176 LBS)

What is the projected total waste for the whole school year? 176 LBS/day X 180 days/year = 31,680 LBS/year

Which grade is projected to produce the most waste per student for the whole year? (The 5th grade = 73 LBS/student/year)

How do you calculate the projected pounds per year of waste for each grade? Here is an example for the first row: (24 LBS/day X 180 days/year) divided by 105 students = 41.14 LBS/student/year

- weigh scale
- waste from lunch in heavy plastic bags, as collected in the cafeteria
- recycling bins for metal and plastic
- lunchroom compost receptacle and outdoor compost bin (optional)

The Whole School

This experiment involves just about everybody in the school—so good communication is key to its success. We discuss the project with the principal. The week before the project, we discuss it with cafeteria staff, lunch aides, and custodians, informing them that parent volunteers will do the weighing of trash. We make any adjustments so that we won't interrupt the staff's work. We also make sure that recycle bins have been placed in the cafeteria and (if possible) a bin for compostable materials (raw fruit and vegetable matter).

Early in our planning, we secure two parents to weigh the trash. These adults will also remind students in the lunchroom about what items on their trays can be recycled and composted.

We work closely with teachers to make sure that the lessons for this project are not just appropriate for particular grade levels, but are integrated with the curriculum at that point in the year if at all possible. If this project happens in September, then students will start off the year with good habits.

Finally, we inform parents of the project in the weekly e-mail message from the PTA and with a handout (see below) that students take home at the start. This allows families time to purchase needed supplies to make it easy to go waste-free.

A Secret Setup

Here are the details of how the project worked at Taylor Elementary School in 2007. At Taylor, each grade K-5 has its own lunch period. Before the lessons begin, parents secretly weighed each grade's trash after each lunch period. These measurements served as our "before trash-reduction" data, which we tallied on a handout sheet and then duplicated, one for every classroom in the school (**FIGURE 1**).

Over the weekend, we set up a bulletin board in the lunchroom featuring the EPA poster "Pack a Waste-Free Lunch." Parent volunteers assembled model lunch kits (wasteful and waste-free) that they would use to teach the 15-minute lesson in every classroom.

The Challenge of Solid Waste

The classroom lessons began one to two weeks before Waste-Free Lunch Week with a short presentation by the teacher about where our trash goes. (In our community, trash is incinerated in Alexandria, Virginia, and then the ash is transported to a landfill in Lorton, Virginia, where it is buried. Arlington Public Schools provides recycling for bottles, cans, and paper.)

The teacher then revealed the fact that a couple of parents weighed the lunch trash from each grade. Up on the board, the teacher wrote the data showing how much trash each lunch period generated (**FIGURE 1**). The teacher performed some calculations with students, as was appropriate for their particular grade. For example, some classes might estimate future waste (How much trash will the school generate in one year?) while others might calculate "equivalents" (Example: A year's worth of lunch trash weighs as much as elephants.). See **FIGURE 2** for examples of these calculations.

Discussing Possible Solutions

Then the teacher asked if students knew how making less trash might improve the environment. In the ensuing discussion, the teacher made sure that these general points were covered: If less trash is generated, then less energy is needed for transportation, incineration, and burial. With less trash, there is less pollution of all sorts, less greenhouse gas emissions, and more resources and land are available for the future. Also, single-use packaging consumes a lot of resources and energy to manufacture. If students are packing their lunches with re-usable contain-

Figure 2. **Estimating Trash Produced in a Year**

There are 180 school days per year. Multiply one day's yield by the number of days to get the estimated total waste for the year.

176 LBS/day X 180 days/school year = 31,680 LBS/school year.

This amount, just shy of 16 tons of lunch waste per school year, is equivalent to:

8 US cars of average size (1 car weighs about 4,000 LBS)

4 elephants (1 elephant weighs about 8,000 LBS)

When we calculate how much trash the typical student produces, the result is 54 pounds of waste per student per year.

(176 LBS/day X 180 days/year) divided by 589 total students = 54 LBS/student/year

The teacher could lead upper grade classes in calculating the numbers above, especially pounds of waste per student per year.

ers and lunchboxes, then materials and energy are saved.

The teacher asked how students might make a difference given the situation of their own school. Packing waste-free lunches can reduce the waste stream a lot. (Students who buy their lunch in the cafeteria can help by taking only what they plan to eat and by composting fruits and vegetables.) Teacher and students discussed the elements of a waste-free lunch, and it became clear that parent participation in our efforts would be needed; in fact, it would be a key to the long-term success of the program. The **HANDOUT** (see page 14), showing how students and their parents can contribute to making waste-free lunches, served as a lesson summary and take-home reminder for kids and parents.

Then the class broke into small groups to practice assembling the parts of a waste-free lunch. The equipment each group has consists of a reusable plastic sandwich container, a cloth napkin, a refillable plastic or stainless steel bottle of water, and a lunch box.

Students had to pack a lunch by choosing wasteful or waste-free options. Examples include apple sauce in a disposable cup versus an apple, single serving snacks versus one in a reusable plastic container, and juice boxes versus a drink in a reusable plastic or stainless steel bottle. Each kit also has a disposable napkin, utensils, and paper bag as opposed to a cloth napkin, reusable utensils, and a reusable lunch box. If a student were to eat all of the food in the reusable containers and take the cloth napkin and water bottle home, then that lunch would result in no trash.[3]

Finally, the teacher explained that last week's measurements were the first part of an experiment. (These measurements can be called the"before-trash-reduction" data.) A second set of measurements can be taken on the Thursday of Waste-Free Lunch Week, and the "after-trash reduction" data can then be revealed in class on Friday. The differences between the two sets of data will show how successful students (and their parents) have been in reducing their lunchtime solid waste.

Figure 3. **Lunch Trash Comparison (Before and After Waste Reduction)**

Parents weighed the amount of material each grade threw away as lunch waste on two different days. Here are the measurements (the raw data) from November 30 and December 7, 2007, in pounds.

Grade	Waste (LBS) on 11/30/07	Waste on 12/7/07	Reduction.
K -	24	16	8
1st -	28	10	18
2nd -	29	10	19
3rd -	22	12	10
4th -	35	20	15
5th -	38	17	11
Totals (LBS)	**176**	**85**	**91**

What is the total lunch waste for December 7, 2007, after families practiced waste reduction? (85 LBS)
How big was the reduction of waste between the two samplings, as measured in pounds? (91 LBS)
How big was the reduction of waste measured as a percentage? (91/176 = 0.517 or 52%)
Do you think that students and their parents made a good effort to reduce the amount of lunch waste generated at school? (Reducing waste by 52% on the first try, which is more than half, seems pretty successful!)

Note: Measurements taken on 12/7/07 for the third and fifth grade lunches have been estimated for the purpose of this article because many students were absent due to field trips on that day, in those grades.

Making Progress

On the Monday of Waste-Free Lunch Week, the teacher devoted from 5 to 10 minutes for discussion of the project. Did parents receive and read the flier? Are students discussing the project with their parents? Are any problems or limitations arising in conversations with adults or other kids? Can students suggest ways to overcome any problems? Do they have novel ideas for reducing the lunchtime waste stream?

On Thursday, the trash was again measured. In our school, an interesting problem arose during the lunch period. Two parents monitored the lunchroom, reminding students to place eligible items in the appropriate bins for recycling and compost. These parents noticed that some students wanted to pack their trash in their lunch containers so that it would not be weighed. The parents pointed out to students that this would not be a "true and fair measurement" of the trash generated on that day. Students then emptied their lunch boxes of trash before closing them, and thus avoided biasing the results in a favorable direction.

Measurable Results

The next day, Friday, the teacher presented the "after reduction" measurements to the students (**FIGURE 3**) and discussed the meaning of the results. Students had cut their lunch waste in half as compared with the earlier measurements! This meant that students at Taylor could reduce the school's lunch waste by eight tons per year if students and parents worked as hard as they had this week to pack a waste-free lunch.

The teacher invited the class to reflect on all aspects of the project, including the effort required to pack a waste-free lunch, the involvement of adults, and the significance of the measurements. What would students do differently if it were announced that trash would be weighed again next week? Students were invited to suggest other actions (in various aspects of their daily lives) that could be taken to "build a bright and sustainable future."[4]

There is, naturally, an interesting question that can be posed to students, if they don't think of it first themselves: "What would it take for our school's lunchtime waste to be reduced to *zero*?"

Notes

1. Teachers can download free items as well as request a free package of posters and booklets (one per school) at www.epa.gov/epaoswer/education/ lunch.htm. A pdf of the Waste-Free Lunch poster is at www.epa.gov/waste/education/pdfs/lunch.pdf. A "Trash Audits" activity is at www.wastefreelunches.org/audit.html.
2. Social studies strands VII PRODUCTION, DISTRIBUTION, AND CONSUMPTION; VIII SCIENCE, TECHNOLOGY AND SOCIETY; IX GLOBAL CONNECTIONS; X CIVIC IDEALS AND PRACTICES. See National Council for the Social Studies, *Expectations of Excellence: Curriculum Standards for Social Studies* (Washington, DC: NCSS, 1994). We aimed as well to meet several Virginia Department of Education curriculum standards for health, science, and math.
3. At this point in the lesson, students could also fill out a chart in which each child lists whether each item in his or her lunch that day is "Reusable, Recyclable, Compostable, or Waste." A sample chart is on the back of the EPA poster. Repeat this activity on the last day of the project for comparison.
4. Facing the Future, *Global Issues and Sustainable Solutions: Population Poverty, Consumption, Conflict, and the Environment* (Seattle, WA: Facing the Future, 2004): 40-43.
5. At Taylor Elementary School, parents serve on the school's science and health curriculum committee and are invited to work with teachers in presenting lessons and activities to classes. The initial presentations in the lesson "The Challenge of Solid Waste" were run by parent volunteers. Teachers and parents would like to thank Principal Robert Hindman for the opportunity to run the Taylor Waste-Free Lunch experiment.

Alison Davis-Holland *and* **Sue Annis** *are parents and volunteer science teachers at Taylor Elementary School, which is a public school in Arlington, Virginia.[5] Alison participates in the parent-teacher Science Curriculum Committee. Having worked as an environmental consultant who dealt with pollution and cleanup, she strives to help the next generation think about the full life cycle of materials and how not to pollute in the first place. Sue, who has worked as an economist, enjoys studying the cost-benefit tradeoffs and incentives that can drive environmentally responsible behavior.* **Steven S. Lapham** *is the editor of* Middle Level Learning.

HANDOUT 1

Handout for Students *and Parents!*

How to Make a Trash-Free Lunch!

Our whole school is running a waste-reduction experiment that takes place over the course of one week. Students can take the lead, and parents can help. Here is how it works:

On a recent day, parent volunteers secretly weighed the trash produced by each lunch period. Now, in their classes, students are discussing problems associated with solid waste and are working with the numerical data to better understand the scale of what is happening. We are discussing possible solutions to the problems raised by solid waste in our community.

We are working on implementing a real-world solution: reducing our own school lunch waste! Students are learning how to pack a **waste-free lunch** by using reusable containers and utensils, recycling any eligible material, and composting fresh fruits and veggie leftovers from lunch.

Soon parent volunteers will again weigh the trash that each group generated during lunch. Then students will compare the data from the two days (before and after waste reduction) and discuss the results of their efforts to pack waste-free lunches. Will we be able to reduce our lunchtime waste? What will the numbers show?

Here are things students and parents can do:

1. Bring (or purchase in the cafeteria) only what you will eat, and no more.
2. Buy unpackaged food (an apple), rather than packaged food (a sealed cup of applesauce) when you are able to.
3. Pack your lunch in re-usable containers, rather than disposable items (like plastic bags)
4. Recycle and compost as much of your waste as you can.

Parent's participation is important:

1. Help your parents pick food that tastes good and healthy for you.
2. Tell your parents if you do not like something, rather than just throwing it out.
3. Take leftovers home so your parents see what and how much you eat.
4. Share all this information with your parents, and tell them about our waste-free lunch project.

Let's pack waste-free lunches every day, all year round!

This handout is based on ideas from the EPA poster "Pack a Waste-Free Lunch," at **www.epa.gov/waste/education/pdfs/lunch.pdf**. These activities involve students in learning math, health, science, and social studies.

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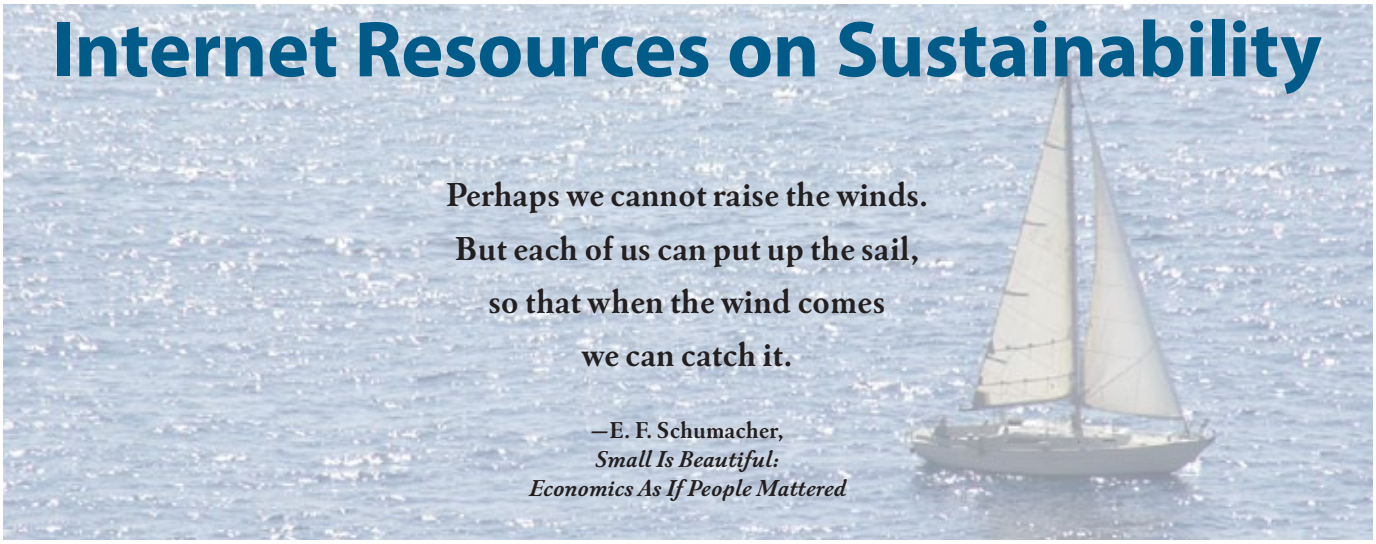
Internet Resources on Sustainability



Perhaps we cannot raise the winds.
But each of us can put up the sail,
so that when the wind comes
we can catch it.

—E. F. Schumacher,
Small Is Beautiful:
Economics As If People Mattered

The U.S. Partnership for Education for Sustainable Development, www.uspartnership.org
The U.S. Partnership consists of individuals and more than 300 organizations and institutions in the United States dedicated to education for sustainable development (ESD). Formed in response to the Decade of Education for Sustainable Development declared by the UN in 2003, the U.S. Partnership acts as a convener, catalyst, and communicator working across all sectors of American society. Click on the link "K-12 and Teacher Education" to get access to a collection of K-12 teaching resources, most of them free; testimonials and working examples; and opportunities for networking with teachers and supporting organizations. Link your efforts to the Partnership; there's no cost, and as a partner, you receive various benefits.

Facing the Future, www.facingthefuture.org
Facing the Future offers curriculum resources on sustainability and related issues such as poverty and pollution. FTF offers free online resources, as well as student textbooks, lesson plans, and thematic units for sale. For example, *It's All Connected: A Comprehensive Guide to Global Issues and Sustainable Solutions* can be used as a stand-alone text for a global issues course or as a supplemental text for other classes ($24.95, 144 pages, 2005). Each unit includes essential questions, stories from the world, youth in action, and curricular connections, and extensive references.

Place-based Education, www.promiseofplace.org
Place-based education is a holistic approach to education, conservation, and community development that uses the local community as an integrating context for learning at all ages. The Place-based Education Evaluation Collaborative (PEEC) recently published a report, "The Benefits of Place-based Education" (**www.peecworks.org/index**), which summarizes five years of study, based on nearly 2,000 surveys and interviews with educators and students from 100 rural, urban, and suburban schools. It concludes that place-based education energizes teachers, helps students learn, and connects schools and communities. It encourages students to become environmental stewards and active citizens.

Vital Climate Change Graphics (UNEP), www.grida.no/publications/theme/climatechange
These neat, colorful images pop up onscreen quickly. First published in 2000 by the United Nations Environment Programme (UNEP), these informative graphics are based on the findings of the Intergovernmental Panel on Climate Change (IPCC). Hundreds of scientists all over the world contribute to the work of the IPCC as authors, contributors and reviewers. The website presents a collection of graphics focusing on the environmental and socio-economic impacts of climate change; updated in February 2005. While you are within the UN family of websites, visit the youth page on climate change (**www.teri.res.in/test/paccify/index.htm**) and the UN Cyber Schoolbus's brief lesson on saving the environment, (**www.un.org/cyberschoolbus/bookstor/kits/english/index.asp**).

Free The Children, www.freethechildren.com/aboutus/index.php
Among human populations, the world's poor are suffering the most from the effects of global warming. Free The Children is a large network of children helping children through education, with more than one million youth involved in our innovative education and development programs in 45 countries. Founded in 1995 by international child rights activist Craig Kielburger (who was 12 years old at the time), Free The Children has received the World's Children's Prize for the Rights of the Child (also known as the Children's Nobel Prize) and the Human Rights Award from the World Association of Non-Governmental Organizations, and it has formed successful partnerships with leading school boards and Oprah's Angel Network. Visit **www.oambassadors.org/global**.

Heifer International, HeiferEducation.org
Heifer International provides sustainable development education resources and opportunities for all ages, including lesson plans, action ideas, activities, multimedia supplements and information about service learning programs. The simple idea of giving families (in poor, rural environments) a source of food rather than short-term relief was the founding idea for this organization more than 60 years ago.