

Paper in Math

Grades: 6

State Standards: Grade 6 Math 2.0, Number Sense, 2.0 Students calculate and solve problems involving addition, subtraction, multiplication, and division and explain why a particular operation was used for a given situation.

Preparation Time: 20 minutes

Activity Time: 30-40 minutes

Key Words: Waste management

OBJECTIVE

The students will identify recycling as an alternative to disposal of paper. A method for determining the cost-effectiveness of a recycling program will be described.

MATERIALS

Bathroom or other scale, calculator, classroom wastebasket, paper grocery bags or cardboard boxes, telephone directory, telephone

BACKGROUND

The Natural Resource Defense Council and Environmental Defense, two of the nation's most influential environmental organizations, each issued reports detailing the benefits of recycling and showing how municipal recycling programs reduce pollution and the use of virgin resources while decreasing the sheer amount of garbage and the need for landfill space -- all for less, not more, than the cost of regular garbage pick-up and disposal.

Michael Shapiro, director of the U.S. Environmental Protection Agency's Office of Solid Waste, also weighed in on the benefits of recycling:

The environmental benefits of paper recycling are many. Paper recycling:

- Reduces greenhouse gas emissions that can contribute to climate change by avoiding methane emissions and reducing energy required for a number of paper products.
- Extends the fiber supply and contributes to carbon sequestration.
- Saves considerable landfill space.
- Reduces energy and water consumption.
- Decreases the need for disposal (i.e., landfill or incineration which decreases the amount of CO₂ produced).

The American Forest and Paper Association (AF&PA) reported that in 1988, about 25 percent of the raw materials used at US paper mills was recovered paper. In 1999, according to AF&PA, that figure rose to 36.3 percent and has remained around 36-37 percent through 2007. More than three quarters of America's paper mills use recovered fiber to make some or all of their products. Approximately 140 mills use recovered paper

exclusively. As a result, virtually all types of paper products contain some recycled fiber. According to AF&PA, the brisk rise in paper recovery is attributable to strong demand overseas for US recovered paper and solid gains in domestic consumption.

PROCEDURE

1. Ask the class to separate paper items from other classroom disposables for one week, segregating them into a suitable collection container. Label the collection container "Recyclable Paper."
2. Discuss with the class ways in which the collected paper might be re-used in the classroom. Are there other uses for the paper in the school?
3. Weigh the paper after one week's collection. Project the weight of paper that might be collected in a month's time, a semester, the school year. Multiply the projected weights by the number of other classrooms in the school. Convert the figures to tons for results greater than 2,000 lbs. Record the projections.
4. Consult the AT&T yellow pages of the telephone directory under "R" for recycling to find the Green Pages section. In the Green Pages find a business that recycles paper. Contact these companies to determine preparation requirements and prices paid for various grades of paper, including mixed ledger (office quality) paper, newsprint, computer paper, corrugated cardboard, mixed wastepaper, and magazines, if any. Determine whether there is a market for the paper collected in the classroom. Inquire whether the scrap paper dealer will provide transportation of the recycled paper for free.
5. What is the current value of the paper collected in the classroom? Would separating the paper into two or more market grades improve its value? If transportation is not provided by the scrap paper dealer, what will it cost to transport the paper to market?
6. Determine whether the recycling effort could be cost-effective on a classroom basis. Compare potential revenues from the sale of the recycled paper to the costs to collect and transport the paper to market. Would it be cost-effective if all the paper discarded in the school could be recycled?
7. Consider the disposal cost avoided if the paper is recycled rather than disposed. Contact the disposal service that collects the school's waste to determine the cost per ton of collection and disposal. Could the "avoided disposal cost" savings improve the cost-effectiveness of the paper recycling effort? (Each ton recycled is one ton less to be disposed.) Could the school save money by recycling paper?
8. Discuss the findings with the class and the school principal. Publicize the results of the study in the school newspaper.
9. Some people argue that recycling uses more energy than it saves, and thus it is not worth the effort. Is this true?

Each year the U.S. uses around 68 million tons of paper and paperboard (www.epa.gov). One ton of recycled paper saves 17 trees. Calculate how many trees can be saved in one year if we recycled.

Paper Recycling Cost-Effectiveness

[weight of paper X scrap price] minus [collection cost + transportation cost] = paper value

weight of paper X [waste collection cost + waste disposal cost] = avoided disposal cost

paper value + avoided disposal cost = paper recycling cost-effectiveness
(note: units of weight and value must be consistent)

ANALYSIS

Students understand purchased goods have landfill environmental impacts, and evaluate reuse, reduce, and recycling in some of their consumer use choices. Students understand the cost-effectiveness of a recycling program.