

Packaging in Math

Grades: 6

State Standards: Grade 6 Math 1.0 Statistics, Data Analysis, and Probability, Students compute and analyze statistical measurements for data sets.

Preparation Time: 25 minutes

Activity Time: 30-40 minutes

Key Words: Packaging, waste management

OBJECTIVE

The students will be able to examine product packaging to determine whether packaging is excessive and whether it is recyclable. The students will be able to identify waste reduction techniques.

MATERIALS

Empty food containers, calculator, postal or other scale, chalkboard, and “What is Recyclable” handout.

BACKGROUND

Every year Californians dispose of 31 million tons of garbage and approximately one third is packaging (<http://www.calrecycle.ca.gov/LGCentral/GoalMeasure/DisposalRate/2009/default.htm>). New state-of-the-art landfills are harder and harder to site. One of the costs and environmental problems associated with the disposal of solid waste, there is growing concern and interest in reducing the amount of waste generated while increasing the amount of waste that is recycled and reused.

Packaging is one area where significant waste reduction can be accomplished. Packaging manufacturers, retailers, and consumers have a tremendous opportunity to make a valuable contribution to the overall resolution of these problems. While there are certainly no absolute formulas or prescriptions for the packaging industry, it is also clear that the traditional view of package design, use, and disposal practices must change.

Working hand in hand, retailers, packagers, and consumers should voluntarily choose to aggressively pursue all possible waste reduction strategies, including waste prevention, reuse, and recycling. (See www.calrecycle.org)

Paper, newspaper and cardboard

Even though paper and paper products can be easily recycled, they still are the most common items in any trash can. Paper and paperboard makes up nearly 40 percent of the waste stream. So which kinds of paper are recyclable? Cardboard, newspaper, and high-quality papers (like paper for notebooks, copiers, computers, letterheads, and envelopes) can all be recycled. Different kinds of paper—like newsprint and high-quality white paper—are sorted into separate piles because they are processed differently. Recycle City

collects just about everything made out of paper that hasn't been coated with plastic, printed with metallic ink, or soiled by food.

Paper is recycled by shredding it into small pieces and mixing it with water. The mixture is beaten into mush, called pulp, that flows onto a moving screen where most of the water is taken out. Wood or paper fibers remain and the fiber is pressed through rollers that squeeze out more water. It is then dried in a steam-heated dryer. The result is recycled paper.

Glass

You can recycle many types of glass. Glass food and beverage containers can be reused and recycled an infinite number of times. (In fact, only light bulbs, ceramic glass, dishes, and window glass can't be recycled. Dishes and ceramic glass can be sold at garage sales, given to someone else, or donated to charity or a community warehouse.) Glass is made from soda ash, sand, and lime. If it's thrown away, it stays there indefinitely because glass never breaks down into its original ingredients. To be recycled, glass is sorted by color, crushed into small pieces, and melted down into a liquid. Then, it is molded into new glass containers. Sometimes recycled glass is used to make insulation and road-construction materials.

Metals

Aluminum is made from bauxite, an ore that must be mined from the earth. It doesn't decompose or break down, so an aluminum can will always be an aluminum can—until someone recycles it! When recycled, aluminum is melted down and reshaped into new cans and other items. Making new aluminum cans from old ones requires only five percent as much electricity as it does to make new cans from bauxite!

Tin-coated steel cans, such as soup and fruit cans, are made of iron ore and tin, which are non-renewable resources. They are the product of geological processes that take millions of years to complete. Once these metals are gone, they are gone forever.

These types of cans require a different recycling process than aluminum cans. As a result, steel cans may not be accepted by some recycling companies. If they're not recycled, cans made of these metals eventually rust and break down, but throwing them away is a waste of valuable resources. To be recycled, these cans are put into a huge container with holes in the bottom and then dunked in a caustic (acid-like) solution to dissolve the tin from the cans. Then, the steel cans are washed and sold as high-grade steel. The dissolved tin is made into bricks which are sold to companies that need tin to make more cans or other products.

Plastic

Plastic is made of petroleum, a non-renewable resource. It makes up almost 10 percent of waste stream's weight, but takes up almost 20 percent of its space (or volume). About half of plastic waste comes from packaging. The rest comes from all kinds of goods, such as computers, radios, disposable razors, and toys. A piece of plastic that is thrown away will stay the same for many, many years. Today, only about five percent of plastic is being recycled, primarily plastic soft drink bottles and milk jugs. In your house, you can find two types of easily recyclable plastics. The plastics from soft drink containers (Plastic #1,

known as polyethylene terephthalate, or PET, for short) are used to make fiber, structural molding, and more containers. Milk jug plastics (Plastic #2, called high-density polyethylene, or HDPE) can make bottles, toys, pipes, crates, and other products. A mixture of these plastics goes into making garbage cans, park benches, plastic "lumber," manhole covers, and even railroad ties.
(See <http://www.epa.gov/recyclecity/recovery.htm>)

Plastic loses some of its original quality through recycling. This is caused by specks of dirt, contamination and the fact that the original molecular make-up can change. So it is not easy to make PET back into the product it was. If some raw material is added, PET can be recycled into the same product. Not all plastics are the same nor can they all be recycled or recycled easily. Something is only recyclable if there is a company out there who is willing to use it to make a new product. If there is no one who will accept the material and make a new product out of it, then it is not recyclable. There may be a company that uses the material to make a new product somewhere in the world (say Southern CA), but the transportation costs to get the material to that factory would be cost prohibitive, and therefore the material would be deemed unrecyclable in our area (but not in Southern CA, in this example). With plastics in particular, how the plastic particles are put together (molded or extruded) changes their chemical make up and make them non recyclable in certain applications. Each type of consumer plastic (determined by the number on the bottom of the container) is used in different applications, that is why we have so many different types of plastics.
(See http://recycling.stanford.edu/recycling/caq_plastic.html)

The names and labels can seem confusing, but they are a necessity in the recycling process. Styrofoam is the trademarked term for a type of expanded polystyrene foam, also known as EPS foam. Styrofoam, plastic foam and other polystyrenes are designated as plastic No. 6, but many recycling programs that accept plastic No. 6 specifically exclude Styrofoam. EPS foams contain a lot of air, which is why they are cost prohibitive to ship. Once the Styrofoam has been melted down and the air removed, little plastic is recovered compared to other polystyrenes such as those used in DVD cases. The resources required to ship and process the EPS offsets the environmental benefits of recycling to a greater degree than denser plastics. (See <http://www.lotfi.net/recycle/plastic.html>)

PROCEDURE

1. Ask each student to bring to class a food container from home. Boxes and packages should be empty. Cans, bottles, jars, etc. must be rinsed clean, and labels left intact. Be sure to include lids or caps. (It may be necessary for the instructor to provide examples and extra containers as needed).
2. Have the class separate into groups according to the container materials the students have provided: aluminum, glass, steel or tin, paper, plastic, multimaterial, etc.
3. Ask each group to examine its container labels and determine the weight of the product. Net weight will identify the weight of the contents only. Gross weight will

denote the sum of the weight of container and its contents. (Most weights will be stated as net weight).

4. Using a scale, have each student determine the weight of his empty container. Each group should complete a chart (on the chalkboard or on a handout) with each student entering the name of his product, the package weight as determined, the weight of the contents, and the gross (total) weight. Consistent units of measure must be used throughout the class (ounces or grams).

5. Have each group calculate the average percent of packaging for the group's products using the formula:

$$\text{Average Percent of Packaging} = \frac{\text{Total Package Weight (A)}}{\text{Total Gross Weight (C)}} \times 100$$

Display the results for each group on the chalkboard.

6. Discuss with the class the various group results. Which packaging material offers the least percentage of packaging weight and which the most? What advantages do each of the packages offer? Does some packaging seem excessive? Are some products packaged in a variety of materials?

7. What implications can be made regarding the cost of packaging, costs for transporting the products, and waste disposal requirements for packaging?

8. Ask each member of the class to examine his container label for the presence of a recycling symbol. Students locating a recycling symbol on the packaging should be asked to define the term "recyclable". (Recyclable materials are those materials which can be collected and processed for use as a raw material in the manufacture of the same or a similar product.) Which packages can be made from recycled materials? Which packages are identified as recyclable? Are any of the packages that do not display a recycling symbol recyclable? (Packages made from aluminum, cardboard, glass, steel/tin, paper, and certain plastic packages, including two liter bottles and milk jugs are recyclable). Does any one group have more recyclable packages than the others?

9. Ask the class to identify methods of reducing waste from product packaging. (Buying products with less packaging, buying products in bulk quantities, buying products in refillable containers, packaging made from recyclable materials, etc.).

Packaging Material:			
	A	B	C
Product	Package Weight	Net Weight of Contents	Gross Weight of Product
1.			
2.			
3.			
4.			
5.			
6.			
Total			
(Note: C=A+B, B=C-A, A=C-B)			

10. Ask the class to identify methods of recycling bulky material waste such as expanded polystyrene (Styrofoam). A pound of polystyrene recycled is a pound of new polystyrene that doesn't have to be created. Currently in the USA expanded polystyrene (EPS) foam packaging is being recycled at a rate of approximately 10-12% each year.

<http://www.greenlivingtips.com/>

Here's a few tips as to what you can do with polystyrene to keep it out of the waste stream for as long as possible.

Keep it as packing - how many times have you needed to pack something for shipping and found you had nothing on hand? Break down large lumps of styrofoam into smaller chunks and keep a bag of it handy

Craft projects – You can use them in all kinds of projects; as paint holders, glue projects with glitter and beads, general accessory holders and drying trays.

Earth911.org - If you're in the USA, there's a search function at the top of the [Earth911](http://www.earth911.org) web site where you can enter the term "polystyrene" and then in the box on the right, enter your location. The search results will provide listings of companies and organizations in your local area that will take polystyrene. Note: be sure to enter "polystyrene" rather than "styrofoam" as the latter, being just a brand name, is unlikely to return any results.

Planters - It can be used in pot plants to assist with drainage and as a filler. The smaller mushroom containers can be used as actual pots, just puncture a whole in the bottom and you have a great planter for your annual bulbs.

Mail back initiative - The Alliance of Foam Packaging Recyclers offers a mailback program to USA residents; whereby you send the polystyrene in via the US mail service.

There's a cost involved (postage), but this may prove more economical to you than carting it somewhere by car. You can learn more about this option. See

<http://www.epspackaging.org/info.html#1>

Sell it! - If polystyrene is something you get a lot of; you might be able to make a few bucks from it. The Recycled Plastic Markets Database allows you to search for buyers of a wide variety of plastics. See <http://www.plasticmarkets.org/plastics/search.html>

ANALYSIS

Students understand purchased goods have landfill environmental impacts, and evaluate reuse, reduce, and recycling in some of their consumer use choices.

- Make your own
- Buy in bulk
- Reusable containers
- Shop responsibly

What is Recyclable in Tehama County?

YES

Recyclable Paper Types:

- White and colored paper (may contain staples, paper clips, sticky notes)
- Newspapers
- Magazines & catalogues
- Phone books
- Envelopes (All types-plastic windows and metal brackets okay)
- Junk mail
- Cardboard or paperboard (please flatten)

Other Recyclable Items:

- Aluminum cans
- Aluminum foil, pie plates, or trays
- Food/Soup cans
- Plastic bottles or containers numbered #1 - 7 on the bottom
- Milk cartons, drink boxes
- Glass bottles and jars
- Empty aerosol cans
- Scrap metal

NO

- NO** laminated paper
- NO** Styrofoam/Polystyrene
- NO** Plastic Wrap
- NO** paper plates or cups with food residue
- NO** large quantities of paper with glue or tape
- NO** laminated paper
- NO** chemical or paint containers
- NO** light bulbs Call 528-1103 for proper disposal
- NO** frozen food, microwaveable or juice concentrate containers
- NO** plastic bags or rubber bands
- NO** liquids (please empty cans/containers before recycling)

Please use orange battery bags for recycling alkaline batteries. Call 528-1103 for details or information about recycling rechargeable batteries.

Remember-reduce, reuse, and then recycle
For a complete list of everything we recycle

