

Making Decisions: Packaging and the Environment

Making the Connection
Women in Engineering & Programs
Advocates Network (WEPAN) Project
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1. The unit has one activity in which students redesign the packaging for some common household products.
2. The activity encourages students to approach the problem as engineers.
3. The activity has a resource page that provides background information.

Environment

Grades 9 & 10 (suggested)

Objective

The goal is for students to understand the basics of engineering associated with packaging of products and the potential impact on the environment. Packaging around consumer products serves many purposes. By holding pre-measured quantities of products, packaging makes items easier to store, ship, stack, and price. Packaging offers protection from damage or breakage, as well as preservation so that food spoilage is minimized. Packages can also provide information about its contents and help in marketing the product.

One strategy that helps to minimize the waste from packaging is source reduction. In contrast to reusing and recycling, this strategy is employed before items are packaged. In effect source reduction means not using packaging that is not needed and using less of what is necessary. Reducing packaging in this manner has the greatest potential to save resources and slow down landfill depletion rates.

Skills & Standards

- Involves decisions related to advantages and disadvantages of packaging and processes.
- Uses resources (people, references, Internet) to gain knowledge.
- Includes consideration of environmental impact.

Activity Outline

Materials required per group: Part 1

Bags containing packaging from 3 items. These may include the following:

- Boxed cookies
- Deodorant
- Allergy medication
- Shoes
- Shampoo
- Frozen pizza
- Detergent
- CD's

Each bag should have packaging from food items, health or beauty aids and some other product.

Materials required per group: Part 2

None

Timeframe:

- Part 1: 40 minutes
- Part 2: 45 minutes

Overview of Presentation

Briefly explain engineering (See Presenter's Guide for more detail.)

Engineers use scientific information to design and create useful things. In designing and creating, the engineer goes through a problem solving process in which both math and science are important components.

Introduce the activity to the students.

Have a general discussion about packaging. Encourage students to share what they have observed about the purposes of packaging. Do not discuss the ways to reduce packaging, that discussion will take place after the activity.

Begin the activity.

Before passing out the materials, present the 'problem' and 'who wants to know' which are listed on the activity sheet.

Do the activity.

Pass out the materials and do the activity. As the students work on it present 'how can you help solve the problem' and 'let's try it' to help them with the brainstorming and testing.

Reflect on the activity.

After the activity is completed, spend time discussing what was discovered and learned. Make a connection between the students' solutions and the various types of source reduction.

Career Connection:

Discuss what types of jobs are involved with packaging. Asking 'Who can help you solve the problem' may help students think about the type of people who would be involved in packaging or environmental issues.

Activity: Redesigning Packaging

This activity has students redesign and justify the packaging currently used in some consumer products. Design criteria include reducing the amount of packaging material by 25%. The activity has been developed based on a traditional engineering design process which pose key questions – all identified in boldface type, that help the students approach the problem as engineers.

Part 1: Redesigning Packaging

What's the problem? The year is 2004 and a surprise, third party candidate has been elected on a platform stressing environmental awareness. The new President proposes that, in addition to increasing our targets for recycling and reusing materials, the U.S. will reduce the amount of packaging being used by 25% within 4 years.

Who wants to know? The Committee for Protection of the Environment is designing alternative packaging that meets these new guidelines to ensure that the 25% reduction target is met. The students will act as engineers for the Committee.

1. Spend a few minutes guiding the students to share their observations about the purposes of packaging. Also discuss the differences between source reduction, recycling, and reusing products. Make sure the students understand that this activity is about source reduction and not the latter two strategies. Give the students Worksheet A: *Mathematics of Packaging* and have them work through the problems. (Answers are included on the next page.) To enhance the math component, you might have students convert the problems to the metric system. This exercise highlights the importance of source reduction in light of the low recycling rates in the U.S.
2. Break the class up into groups of 3 or 4 students. Give each group a bag containing the packaging from three products.

How can you help solve the problem? Think about the reasons that each kind of packaging is used. With those as a starting point, think about ways that the packaging could be reduced without compromising the product in any way. It may be necessary to alter the product slightly such as eliminating water to reduce bulk.

3. The students should use the table on Worksheet B: *Packaging* to help them determine the purpose of each piece of packaging material. Have students think about whether the packaging is necessary and if so, how it might be reduced.

Let's try it! Put your idea to work and redesign the packaging. Continually ask yourself if the new packaging does everything that the old packaging did. If not, make sure that you can justify this.

4. Have students draw the new packaging and discuss the ways that they changed it and why.

Part 2: Sharing Solutions

Will your suggestion(s) work? How good was your packaging? Does it meet the 25% reduction goal but not compromise the product in any manner?

5. Have each group of students decide which of their packaging solutions they are most proud of. Then ask for a group to volunteer to show their design and explain its merits.
6. After the group has explained the design, highlight which of the four methods of source reduction they utilized (lighter weight materials, larger/bulk packaging, flexible rather than rigid packaging or concentrated products). See Activity Resource Page for explanation of four methods. You may want to start a list of these methods on the board.
7. Ask another group, who used a similar strategy to explain what they did. This will show how the same strategy may be suitable for many different products. If no groups used the same strategy, then ask a group that utilized a different strategy to share their design with the class.
8. Allow each group to discuss a packaging solution. If all four methods of source reduction have not been discussed, use examples to try to get the students to discuss all four methods.

Who can help you solve the problem? What type of information or knowledge will help you as you work on this problem?

Engineering Summary: Finish with a discussion about how students approached the problem as engineers.

Activity Resource Page

Background Information for Activity Leader

The Environmental Protection Agency (EPA) estimates that one-third of America's municipal solid waste comes from packaging. Given that, it is possible to make a significant impact on the environment by adopting packaging that is highly functional yet minimally wasteful. Some elements of this strategy, which is known as source reduction, include:

Lighter Packaging. Surprisingly, this is more important than using recyclable packaging. Since recycling levels are currently so low, we can usually create less packaging by choosing lighter-weight materials. (For an example, see Worksheet A: Mathematics of Packaging.) When it comes to weight, paperboard, plastic, and aluminum are all efficient packaging choices.

Larger-sized Packaging. In addition to providing cost saving, buying things in bulk provides packaging savings. (See example in Worksheet A: Mathematics of Packaging.) Consumers should only buy quantities that can be used up so that spoilage does not offset the packaging reduction benefits.

Flexible Vs. Rigid Packaging. Flexible pouches can weigh up to 75 to 90% less than the rigid containers that they replace. They are also easier to compact, which means they take up less space in landfills. A dramatic example to illustrate this is that juice boxes are 90% lighter and take up 70% less volume than the glass bottle they replace.

Eliminating or Reducing Water. Having products in concentrated, powdered or dried forms allows for more efficient packaging. Powdered detergents are now available in concentrated forms, so the consumer gets more washes from a smaller box.

Questions to Ask

As you go through this activity with the students, lead them through the process by asking the questions provided in the design approach of the activity. Encourage them to be creative with their solutions.

Q: What are the other advantages of lighter packages?

A: They typically contain less material that needs to be recycled and they also cost less to ship since not as much gas is required for transporting them.

Q: What are the recycling rates for commonly used materials?

A: Aluminum is best with a recovery rate in the 60 to 65% range. Glass is recycled at a rate of just under 40%, while the rate for plastic recycling is currently about 10%.

Q: Are there any advantages to packaging food?

A: First, packaging keeps food from spoiling which means it can be eaten and not put in landfills. Second, packaging lets us process food more efficiently. For example, when chickens are packaged at a plant the feather and other "waste products" are processed into other usable things. When butchers processed the chickens, these items were usually thrown away.

Tips

Involve local experts to enhance the activity. Contact an engineering school at a local university, WEPAN at www.wepan.org, or the Society of Women Engineers at www.swe.org.

Vocabulary Words

Recycle – to use something over again

Source reduction – not using what we do not need and using less of what we do

Expanding the Activity

- 1) Have the students bring in products from home. Determine the ratio of packaging weight to product weight. What sorts of products have high/low ratios?
- 2) Research other countries to see if their reduction, recycling and reuse efforts are similar to ours.

Additional References

<http://www.cygnus-group.com/packaging/Packaging.html>

<http://www.cygnus-group.com/packaging/study/Topline.html>

<http://www.epa.gov>

Worksheet A: Answer Guide

A. Materials and Impact on Landfill

Q1) 55% of the steel will end up going to the landfill. This means that 11 pounds of steel will end up in the landfill.

$$[20 \text{ pounds} \times 0.55 = 11 \text{ pounds}]$$

3 pounds of vacuum pack material will end up in the landfill.

Q2) 85% recycle rate. At this rate, the steel produces 3 pounds of excess material that will end up in the landfill.

$$[1 - (3 \text{ pounds}) / (20 \text{ pounds}) = .85]$$

B. Buying in Bulk

Q1) Each small box has a surface area of 153 square inches. The 8 boxes have a total of 1224 square inches.

Q2) Each large box has a surface area of 342 square inches. The 2 boxes have a total of 684 square inches.

WORKSHEET B: PACKAGING

	#1	#2	#3
What is the product?			
First packaging material used?			
Purpose(s) of that packaging material?			
Second packaging material used?			
Purpose(s) of that packaging material?			
Third packaging material used?			
Purpose(s) of that packaging material?			

Look at the packaging that you have listed in the table above. Circle the packaging that you think is necessary. Cross out the packaging that you think you can do away with. Then use this information to help you decide on your final redesigns for the product packaging.