

Designing a Package that Works

Making the Connection
Women in Engineering & Programs
Advocates Network (WEPAN) Project
Funded by Lucent Technologies Foundation

Environment

1. This unit has students design, build and test packages for transporting a fragile item. It connects how engineers design, build, and test solutions.
2. The activity has a resource page that provides background information.

Grades 3 & 4 (suggested)

Objective

The goal is for students to understand the basics of engineering associated with the packaging of items to preserve, market, and safely deliver products. The packaging for each type of use varies. While observing and thinking about all packaging is encouraged, this activity focuses on packaging for transporting goods (shipping).

When an item is shipped from one location to another, either from a manufacturer to you as a consumer, or something from you to a friend or relative, it is important that the item not be damaged in transit. Good packaging, in terms of minimal damage to the shipped item, is often wasteful and uses excess materials. These materials are also often bulky and can be difficult to recycle. Packaging designers are constantly testing and implementing new ideas in order to overcome high cost and recycling issues. Engineers who work in this field can be materials engineers, environmental engineers or chemical engineers.

Skills & Standards

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

Activity Outline

Materials required per team: Part 1

- Examples of packaged goods for discussion
- A sheet of paper to draw their package
- One 9x12 envelope(plain or from U.S. post office)
- 1 plastic sandwich bag
- 1 raw egg

And assorted materials such as:

- Cardboard, scrap paper, newspaper, cotton balls, scissors, masking tape, aluminum foil, styrofoam peanuts, and bubble wrap.

Materials required: Part 2

Measuring tape
Digital Scales

Time frame:

Part 1: 35 minutes
Part 2: 50 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 how things are packaged. Get them to focus on what packages are like for things that are shipped from one location to another.

Begin the activity.

Before passing out the materials, present the '*problem*' and '*who wants to know*' which are listed on the activity sheet. Put the students in teams of 2 or 3. Having several volunteers to assist will be very helpful.

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. Was there additional information that would have been helpful? Are there other ideas that could be tried? Present '*will your suggestion work*' to think about potential re-tests

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 know.

Activity: Packaging Design, Construction, and Testing

This activity has students design and build a package for 'shipping' an egg. They use design criteria that engineers use, including transit with no breakage, low weight, and a recycle/re-use component. 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: Package Design and Construction

1. In advance of the activity, put each raw egg into a sandwich bag and loosely tape it closed. This is to help prevent major messes!

What's the problem? You need to ship a fragile item and make sure it arrives safely. Along with the safe arrival of the item, you are also trying to create an efficient, earth friendly solution that uses minimal materials.

Who wants to know? The ShipltQuick Company is looking to hire a new packaging engineer. As part of the application process they are evaluating actual package designs, based on using a 9x12 envelope, from each applicant. Spend a few minutes guiding the students to share their observations about packaging that they have seen. You can show a few examples of packaged products.

How can you help solve the problem? Think about all the types of packaging already discussed. Using those as a starting point, have students create a new idea, or use one they think will be best, for packaging a raw egg in a 9x11 envelope.

2. Pair the students into teams of 2 or 3. Give each team a set of packaging supplies, a piece of paper, and *Worksheet A: Packaging Evaluation Sheet* available to consider.
3. Have each team brainstorm and draw a picture of how they plan to package the egg.
4. After drawing the design, give students an egg in a plastic bag, and a 9 x 12 envelope. Students should construct their package with the egg inside it based on their drawing.
5. Have students begin to fill in the information on Worksheet A. Students should weigh and measure the packing materials.
6. Discuss what types of tests might be used to determine if a package is effective.

Part 2: Package Testing

Will your suggestion(s) work? How good was your packaging idea? Are the tests you developed reasonable for determining the effectiveness of your package? How about the amount of materials used and their recycle-ability?

Let's try it! Put your idea to work.

7. Have students, with the assistance of adult volunteers and begin testing their package according to the instructions on Worksheet A and fill in their results. Students should put their package into the 9x12 envelope after they weigh and measure the package.
8. Create a table on the blackboard so each team can fill in their results. The columns should include: Name of Team, Total Weight of Package, Total Measurements, Number of "yes" Answers. The teacher or leader will identify the best package by looking for the lightest weight, the smallest linear measurements and most number of "yes" questions.
9. Be sure to mention that cost is another factor that engineers need to consider in developing a good package even though it was not discussed in this project.
10. After this testing is complete compare the packaging designs that were effective. Discuss the similarities and differences. Why is it difficult to create completely earth friendly packaging? What would the student change if they were to redesign their packages?

Who can help you solve the problem? What type of information or knowledge would have helped you as you worked on this problem?

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

Activity Resource Page

Background Information for Activity Leader

While many items that are shipped are not fragile, such as paper documents, effective packaging in terms of minimizing waste is still an important criterion.

Safe shipment of fragile items is critical to businesses and consumers. The design of effective packages includes structural support and cushioning for the item.

Cost effective packages use a single type of cushioning that is light and easy to manufacture or obtain. Some examples include

- foam peanuts,
- small, linked airbags
- blowing a foam that hardens in the container around the item (which is wrapped in plastic to protect it.)
- pre-formed styrofoam molds to hold the item (most often found for packaging of electronics such as TVs, radios, stereos, etc.)

Packaging ideas that are good for recycling include shredded newspaper, popcorn and packing peanuts made out of potato starch.

Questions to Ask

As you go through this activity with the students you should 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.

Additional questions to ask:

Q: What are the advantages of lighter packages?

A: They typically contain less material that needs to be recycled and they also cost less to ship. For large items, not as much gas is required for transporting them. For small items, less postage is required.

Q: What are the disadvantages of lighter packages?

A: There is less mass to absorb sudden shocks (such as being dropped) to the package.

Q: What advantage does a preformed internal item holder provide?

A: It holds the item in place so that it is equally protected on all sides.

TIPS

Include several adult volunteers to assist student groups.

Involve a local expert to enhance the activity. Contact the 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

Expanding the Activity

1. Make a poster of all the types of packaging you find in your home. This can include packaging for shipping, marketing, and product life. Students can share information about the type of packaging they believe is effective.
2. Research shipping companies like Mailboxes Etc., FedEx and UPS. What are they doing to ship products safely with minimal waste?

Potential Safety Issues

Handling the broken eggs could be messy.

Additional References

[Http://cygnus-group.com/packaging/study/topline.html](http://cygnus-group.com/packaging/study/topline.html)

[Http://www.inform.org](http://www.inform.org)

[Http://environment.about.com/Msubrcy7.htm](http://environment.about.com/Msubrcy7.htm)

[Http://www.ciwmb.ca.gov/WPW/Coordinator/Articles/ShipPack.htm#02c](http://www.ciwmb.ca.gov/WPW/Coordinator/Articles/ShipPack.htm#02c)

[Http://www.fpintl.com](http://www.fpintl.com)

Worksheet A: Packaging Evaluation Sheet

Team Name _____

WEIGHT FOR SHIPPING

- Weight of Product (egg in its bag): _____
- Weight of Packaging Materials: _____
- Total Weight of Product (egg plus packaging materials): _____

LINEAR MEASUREMENTS

- Length of Package _____
- Width of Package _____
- Height of Package (at highest point) _____
- Total Linear Measurement of Package (length + width + height) _____

RECYCLABLE MATERIALS

1. Can your packaging materials be recycled? Yes ___ No ___
2. Can your packaging materials be compacted? (crushed) Yes ___ No ___

SURVIVABILITY TESTS

Drop Test: Drop your package from different heights and answer the following questions:

3. Did your egg survive a drop from one foot? Yes ___ No ___
4. Did your egg survive a drop from two feet? Yes ___ No ___
5. Did your egg survive a drop from three feet? Yes ___ No ___

Stacking Test:

6. Place a large textbook on top of your package. Did your egg survive? Yes ___ No ___

Impact Test:

7. Drop the textbook onto the package from one foot above the package. Did your egg survive? Yes ___ No ___

How many questions did you answer "yes" to?

Total "yes" answers ___