

Snack Attack: Food Packaging

Making the Connection
Women in Engineering Programs &
Advocates Network (WEPAN) Project
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1. This unit explores the design process and materials used to package food.
2. This activity has students assuming the role of an engineer by designing and testing a package for a snack.
3. This activity has a resource page that provides background information.

Environment

Grades 5 & 6 (suggested)

Objective

The goal is for students to understand the basic engineering involved in designing food packaging. Food has a long journey from where it is manufactured to when it reaches the mouth of a consumer. Along the way it can be dropped, rained on, left on a cold loading dock, or spend time in a warm pocket. During that time packaging protects the food from damage and contamination.

Packaging engineers must work to ensure that food arrives in the best possible condition while using materials that are cost effective and environmentally friendly.

Skills & Standards

1. Develop an understanding of engineering in terms of involving decisions related to advantages and disadvantages of process and products.
2. Identify relevant design features for building a prototype of a solution to a given problem.
3. Identify materials used to accomplish a design task based on a specific property.

Activity Outline

Materials required per group:

- 3 or 4 snack foods with different packaging such as candy, chips, cookies.
- Marshmallows
- Chocolate bars or squares
- Graham crackers
- Baking pan/aluminum pie plate
- Paper towels
- One measuring cup of water
- Stapler, masking tape, scissors
- Lightweight cardboard or cardboard from butter and light bulb boxes cut into 3" squares
- 6" x 3" pieces of aluminum foil, wax paper, and plastic wrap.
- small foam plates cut in half
- toothpicks

Other materials:

- 2 hair blowers
- 2 stop watches or watch with second hand

Time frame:

- Part 1: 30 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 the math and science are important components.

Introduce the activity to the students.

Have a general discussion about how food gets from the manufacturing plant to your house. Encourage the students to think about the different situations food can encounter during transport and what packaging is used to protect it.

Begin the activity.

Before doing the activity, present the 'problem' and 'who wants to know'.

Do the activity.

Break the class into groups of 2 or 3 students depending on amount of materials and class size. **It will be VERY helpful to have an adult assisting the leader with this activity.** Encourage the students to note the differences and similarities between packaging for similar types of food such as chocolate candy.

Reflect on the activity.

After the activity is completed, spend time discussing what was discovered and learned. Look at the existing food packaging as well as the ones created by students. Discuss what characteristics and materials they have in common.

Career Connection

Discuss what types of jobs including engineering are involved with designing, testing, and developing food packaging. Asking 'Who can help you solve the problem' may get students to think about the type of people who would know.

Activity: Snack Food Packaging

The students will analyze the packaging of snack food products currently on the market and design their own solution to a packaging problem. 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: EXAMINING FOOD PACKAGING

What's the problem? Snack food has to survive a rigorous journey from manufacturing site to when it is consumed. Evaluate the packaging of existing products to determine what methods effectively protect from conditions.

1. Lead a discussion on how food gets from a factory to your mouth. Make a list of conditions that food might experience. (See Activity Resource Page.)
2. Break the class into groups of 2 or 3 depending on amount of materials and size of class. Give each group *Activity Sheet 1: Observing Packaging* and an assortment of 3 or 4 snacks.
3. Have each group make a list of the materials used in their snack and identify which materials are used to protect the food from different conditions.
4. Lead a discussion on what broad categories these materials could be divided into. Ask the students which materials protect from which conditions. Ask them to consider which materials are recyclable.

PART 2: DESIGNING YOUR OWN SNACK PACKAGING

Who wants to know? A new candy company wants to package individually wrapped, ready to heat s'mores that can stay fresh in the wilderness or on a camping trip.

How can you help solve the problem? Use the knowledge of existing packaging as well as your own ideas to design packaging for ONE s'more.

1. Put the students back into groups and present students with the following problem: A new candy company wants to package individually wrapped, ready to heat s'mores – consisting of two squares of graham cracker, a piece of chocolate, and a marshmallow. S'mores are often taken on camping trips and therefore subject to a variety of environmental conditions. After some testing, the condition that the engineers are having the most problems with is making their packaging weather proof. Design a package to protect a s'more from HEAT and WATER.
2. Give each group *Activity Sheet 2: Experiment and Cost* and the following items:
 - 2 paper towels, 2 graham cracker squares, 1 piece of chocolate, and 1 marshmallow
 - baking pan, one measuring cup of water, stapler, scissors, and tape
3. Review the experiment together.
4. Arrange a "heat testing station" supervised by the teacher or an adult that includes one or two hair blowers and 1 or 2 stop watches or watches with a second hand. Students can time the test while the adult uses the hair blower.
5. Set up a "store" where students can purchase the packaging materials. Have the students submit their cost sheet so you can give them a "cost score". The most expensive package gets 1 point, the least expensive package gets 8 points (if there are 8 groups). The rest are ranked in order of cost.
6. After a few minutes of planning, have one student per group come to the store with *Activity Sheet 2* identifying the items their group has selected and the total cost.
7. As each group finishes their package, hand out *Activity Sheet 3: Test Instructions* and have the groups come to the testing station. Test the product and have the students complete the form
8. After testing, have each student group (or just two or three volunteers) present their packaging design.
9. Lead a discussion evaluating the different designs presented. Which designs protect best against heat? Which designs protect best against water or contaminants?

Will your suggestion(s) work? Is your design feasible? How much material does it use? Is it environmentally friendly? (See *Additional Questions to Ask* on Activity Resource Page.)

Who can help you solve the problem? What type of information or knowledge is needed to understand food and packaging materials? Chemical engineers have knowledge of the reaction between food and materials. Mechanical and materials engineers understand packaging material properties including strength and heat transfer.

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

Activity Resource Page

Background Information for Activity Leader

Packaging for food serves to protect the consumables inside of it. Food packaging keeps goods from being damaged during shipping and keeps the contents fresh. During shipping, food can encounter a number of different environmental conditions ranging from drastic changes in temperature to rain or chemical exposure. Food packaging continues to be important once the product has been purchased. It aids the consumer in preserving and dispensing the food.

There are three major groups of materials used to package food: flexible, semi-rigid, and rigid. Flexible materials include paper (laminated and waxed) and plastic films. Aluminum foil, paperboard, and formed plastic are in the semi-rigid category. Metal, glass, and thick plastic are considered rigid materials.

Paper, plastic, and aluminum foil are popular packaging materials in the snack food category. Plastic packaging materials are the most versatile as they are able to vary dramatically in shape and strength. Resistant to air, moisture, and in some cases light, plastic is used in bags, wraps, and bottles. Recycled plastic products can be manufactured into high tech lumber, trash cans, and even new plastic containers. Aluminum is the cheapest material that can block light, air and moisture. However, aluminum can react with certain food products adversely affecting tastes and storage. Paper products are popular as a packaging material because they are easy to customize. Special laminates can be used to make paper resistant to water. Paper products are also the only packaging material that comes from a renewable natural resource.

A material's ability to protect food from changing temperatures depends on the thickness of the material and how well (or how poorly) the material conducts heat. Paper, plastic bags/wrap (polyethylene), and cardboard are the poorest conductors of heat. Styrofoam and glass are slightly better conductors of heat while aluminum and other metals are excellent conductors of heat.

TIPS

Each part can be done on different days.

Involve local experts 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.

Making the Connection

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Questions to Ask

As you go through this activity with the students you should encourage them to think about which types of food packaging they've found to be useful.

Additional questions to ask:

- Q. How do companies decide which kind of materials to use in their packaging?
- A. Food packaging needs to protect the food, be environmentally responsible, and be economically feasible for the company. The cost of the materials needed heavily influence decisions. The weight of materials as well as the size of packaging also has a significant impact on decisions as larger, heavier packaging increases shipping costs. In addition, the more material used, the less environmentally friendly and cost-effective it will be.
- Q. Is the ability to recycle a material the only Factor that makes it environmentally friendly?
- A. No. The ability to recycle a material is one aspect of being environmentally friendly. It is also important how much material is used overall, and how much energy is needed to manufacture a product. If a great deal of heavy equipment and machinery is needed to create a material more pollution (air, water, thermal), is generated.

Vocabulary Words

Expanding the Activity

1. Students can design and test for other packaging situations. Conduct a crush test by placing a small weight on each package.
2. Have students put together a poster identifying various types of packaging for snack foods and identify which are recyclable or biodegradable.

Potential Safety Issues

Take care when handling chocolate after heating. It can burn and stain.

An adult(s) should assist groups while conducting the heat test. The heat test should be done at a separate station from the water test.

Additional References

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

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

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

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

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

Extensions for Advanced Students

If the students are more advanced they can use thermometers or temperature probes to more quantitatively calculate which materials are better for protecting food from heat.

Activity Sheet 1: Observing Packaging

What materials are used in the packaging?

Which materials do you think protect the foods from water or rain?

Which materials do you think protect the foods from breaking?

Which do you think protect the foods from heat or cold?

Activity Sheet 2: Experiment and Cost

Experiment: Create a package that will keep your s'more cool and dry. It will need to keep your chocolate and marshmallow from melting during the heat test (45 seconds under a hair dryer on high). Your package will also need to keep your graham cracker and marshmallow dry when 1 cup of water is poured over it. Cost is another concern. Engineers want to design good packages at the lowest possible cost. You have a budget of **50 cents** which means you can not spend more than 50 cents on your package but you can spend less.

Your package will be scored in two ways.

1. **Test performance:** Your package will be rated from 0 to 40 based on how well it performs in the two tests.
2. **Cost:** Your package will get a cost rating from your teacher or the "store manager". The package that costs the least (which is what you want) will get the most points. The package that costs the most will get the lowest number of points. Hand in your cost sheet to receive your "cost score".

Supplies to purchase:

<i>ITEM</i>	<i>Quantity</i>	<i>Amount</i>	<i>Total Cost</i>
Cardboard pieces		10 cents each	
Aluminum Foil 6 inch square		8 cents each	
Wax Paper 6 inch square		5 cents each	
Plastic Wrap 6 inch long piece		10 cents each	
Small Foam Plate cut in half		15 cents each	
Toothpicks		2 cents each	
		TOTAL (Can not be more than 50 cents!)	

Activity Sheet 3: Test Instructions **Team Name:** _____

- 1) Place a small piece of tape on the bottom of each package (to prevent movement when blow drying) and place it in the center of the baking pan.
- 2) Bring your package in the pan to the "heat testing station".
- 3) Your teacher will hold the hair blower at 6" from the top of the package directly over the package and blow dry on the "high" setting for 45 seconds.
- 4) Now go back to your desk area and perform the water test on your package.
- 5) Hold 1 cup of water 6" from the top of the package, directly over the package, and pour it over top of the package.
- 6) Unwrap the package and look at the results.
- 7) Based on the results of the test, fill in this form.

Heat Test

Chocolate

Not melted (solid): 10 points

Partly melted: 5 points

Completely melted: 0 points

Points Awarded _____

Marshmallow

No browning: 10 points

Partly or completely brown: 0 points

Points Awarded _____

Water Test

Graham Crackers

Dry : 10 points

Damp: 5 points

Wet: 0 points

Points Awarded _____

Marshmallow

Dry: 10 points

Damp: 5 points

Wet: 0 points

Points Awarded _____

Cost Score

Points Awarded _____

(get this from your store manager" or teacher)

TOTAL SCORE _____