

Can you design and construct a better candy bag?

Grade Level: 5 and 6 (introduction to the engineering design process) 5 (content → volume vs. weight)	Total Time Required: 60 minutes
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Source: <http://www.tryengineering.org/lessons/candybag.pdf>

Lesson Objectives:

In this lesson, students will be able to:

1. Identify and describe how design impacts the performance of a product.
2. Use the engineering design process to design, construct, and test a better candy bag.
3. Collect data on the performance of their product and make evidence-based claims about the product's performance.

Indiana Standards:

- 5.PS.4** Describe the difference between weight being dependent on gravity and mass comprised of the amount of matter in a given substance or material.
- 3-5.E.1** Identify a simple problem with the design of an object that reflects a need or a want. Include criteria for success and constraints on materials, time, or cost.

Next Generation Science Standards

- 3-5.ETS1-1 Identify a simple problem with the design of an object that reflects a need or a want. Include criteria for success and constraints on materials, time, or cost.

Science/Engineering Practices

1. Asking questions (for science) and defining problems (for engineering)
6. Constructing explanations (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence

Crosscutting Concepts

2. Cause and effect: Mechanism and explanation.

Concepts and Vocabulary

<i>Term</i>	<i>Defined by a scientist or engineer</i>	<i>Defined by a student</i>
<i>Weight</i>	A unit measure of gravitational force. Weight is dependent on gravity.	How heavy I am.
<i>Mass</i>	Amount of matter in a given substance or material.	How much stuff is inside something.
<i>Volume</i>	Amount of space an object or substance takes up or occupies.	How loud something is or How big something is.
<i>Prototype</i>	A model of a proposed design.	

Equipment, Materials, and Tools

Materials		
16 in x 16 in pieces (or larger) of thin plastic material (i.e., plastic painters drop cloth or plastic sheeting) or paper (i.e., painter's drop cloth, bulletin board paper)	Items to check for weight, such as rice, beans, or candy	Books, bottles of water, candy, blocks, or other objects to be used as weights
Masking tape (1 roll)	String or twine	

Tools		
Rulers	Spring scales (2 to 3)	Triple beam balances (2 to 3)
Measuring cups (2 sets, optional)	Scissors (to cut string)	

Blue Hawk Builder's Paper Drop Cloth (Common: 2-ft x 140-ft; Actual 2.33-ft x 140-ft):
<https://www.lowes.com/pd/Blue-Hawk-Builder-s-Paper-Drop-Cloth-Common-2-ft-x-140-ft-Actual-2-33-ft-x-140-ft/50053433>

Notes:

See <http://www.heinemann.com/products/E00469.aspx> to learn more about different ways to introduce inquiry-based activities about packages and packaging.

Synopsis of Engineering Design Activity

Synopsis of the Design Activity:

Problem:	Your boss at the Sweet-Tooth Candy store has learned that customers would like to have a candy bag that is attractive and more functional than the one they currently use when they shop in the store.
Goal:	Your boss has asked your team to design and build a new and improved candy bag that is sturdy, functional, and attractive.
Who is the client:	Your boss at Sweet-Tooth Candy store
End-User:	Customers
What is the design:	Design an improved candy bag.
Criteria:	<ul style="list-style-type: none">• Hold maximum weight.• It is attractive.
Constraints:	<ul style="list-style-type: none">• Materials available.• Allotted time for construction in the classroom.

Lesson Plan #1

Guiding Question – What are the unique features of different bags? Can you design and construct a better candy bag?

Time: one 30-minute session

Procedure:

1. Ask students to consider the following questions:
 - *What makes a shopping bag effective (strong)?*
 - *What are some features that make a bag strong? (List on chart paper)*
 - *What makes a shopping bag attractive?*
 - *What are some unique features that make a bag attractive? (List on chart paper)*
2. Distribute the Design Challenge to students.
 - *What is the problem?*
 - *Who is the client?*
 - *Who is the user?*
 - *What are the criteria?*
 - *What are some of the parameters you have to work within (constraints)?*
 - *What materials and tools have been provided?*
3. Have students work individually on his/her plan then share their plan with a team of three or four students. Draw the candy bag your team agreed upon for your first design. Be sure students label and list all the materials they will need. Include how large it will be, and your estimate of how much weight it will hold.
4. Once students have created their plans, instruct them to test their original design and add enough weight to break the bag. Students can then redesign their bag and draw the new design in their notebooks.

Lesson Plan #2: Design Testing

Time: one 30-minute session

Procedure:

1. Instruct students to conduct three trials of their designs. Students record the amount of weight the bag held as well as score their designs on level of attractiveness.

Table 1: Measurements for Candy Bag Trials

<i>Trial</i>	<i>Estimated Weight the Bag Can Hold</i>	<i>Actual Weight the Bag Can Hold</i>
1		
2		
3		
Average		

Table 2: Level of Attractiveness Scale

<i>Level of Attractiveness</i>		
<i>0</i>	<i>1</i>	<i>2</i>
No appealing features	Contains one appealing/interesting feature	Contains two or appealing/interesting features

2. Students share their results and determine which bags met the client's needs (attractive and more functional than current bag used in the store).

Assessment

The following are possible sources of formative and summative assessment:

Formative

Monitor students' initial designs in their design notebooks. Consider how well students labeled their designs; listed all the materials needed and used; and estimated the weight and bag performance.

Summative

Assess students' final designs based on performance (weight) and level of attractiveness.

Additional assessments may include a persuasive letter to the candy shop explaining why their bag should be selected.

Lesson Extensions and Resources

Activity Extensions:

Incorporate a “good green” theme to the bag design. Encourage students to bring in recyclable materials and to construct bags that are Earth friendly.

Assign a cost to all the materials and encourage students to construct a bag that is functional, attractive and cost affordable.

Explore other scientific principles behind packaging. Consider the following tests: 1) strength, 2) compression, and 3) package ruggedness. Students could generate their own types of tests and perform investigations using these tests.

Visit a candy store and interview store owners about how they make decisions about packaging.

Web Resources:

www.tryengineering.org – Access the Better Candy Bag task as well as other engineering design-based lessons.

Design Activity

Student Resource

Design and Construct a Better Candy Bag

Source: <http://www.trvengineering.org/lessons/candybag.pdf>



You and your partners are employees of the Sweet-Tooth Candy store. Recently your boss has learned that customers would like to have a candy bag that is attractive and more functional than the one they currently use when they shop in the store. Your boss has asked your team to design and build a new and improved candy bag that is sturdy, functional, and attractive. She is interested in a candy bag that is able to hold maximum weight and that is attractive, but she has not specified minimum dimensions or the amount of weight the bag must hold.

The design, construction method, and materials used will determine the strength of a bag. You will want to test the strength of your candy bag and will redesign and retest as needed. Measurements may be taken to determine how to improve the strength of your candy bag and to estimate the weight of the bag will hold.