Title:	**Grade:**	**BIG Idea:**
Designing a Movie Popcorn Container: A Culminating Task	6th **Author**: Hope Phillips	Volume of Solid Figures

Real-World Connection:

Students are likely aware that our national economy is still struggling. They know that most Americans do not have as much income as they used to have. Prices for may goods/services are higher than they were several years ago – for gas, groceries, clothes, etc. Manufacturers of products we use every day have altered the sizes of their containers (i.e. cereal box, can of beans, body lotion, etc.). Even though the consumer is getting less product, we are paying, at least, the same as the cost of the previous version of the product, and, sometimes, more.

How Students will Experience the Connection: highlight in yellow all that apply

Video Clip	Photo	Podcast
Print Media (article, ad, etc.)	Vodcast	Other

GPS Standards:	**Objectives:**
M6M3. Students will determine the volume of fundamental solid figures (right rectangular prisms, cylinders, pyramids and cones). b. Compute the volumes of fundamental solid figures, using appropriate units of measure. d. Solve application problems involving the volume of fundamental solid figures. **M6P1.** Students will solve problems **M6P2.** Students will reason and evaluate mathematical arguments. **M6P3.** Students will communicate mathematically. **M6P4.** Students will make connections among mathematical ideas and to other disciplines.	1. Students will create open rectangular prisms (no bases – top or bottom) from sheets of 9" x 12" paper. 2. Students will determine the volume of rectangular prisms using appropriate units of measure. 3. Students will provide a rationale for the rectangular prism that would maximize company profits.

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Materials:

Per Student:

- 9” x 12” construction paper **OR** inch grid paper
- pencil
- ruler
- four-function calculator
- Worksheets #1 and #2

Per Group of Two or Three Students:

- clear tape
- popped popcorn; packing peanuts; or similar material for filling prisms
- cups for scooping popcorn/similar material (use different sizes of cups for each group)
- clean paper to place prisms on for filling with popcorn
- markers/colored pencils (optional)

Teacher:

- household products (see explanation in *Related Task)*
- 9” x 12” construction paper or inch grid paper
- Articles and/or video clip (see *Learn More* section)

Related Task:

Discuss with students the real-world connection above. Have students read one (or both) of the articles and/or show the video clip (see *Resources* section). Bring in household products that are examples of this new packaging model. Examples include: rolls of toilet paper that are shorter; plastic containers of orange juice that do to not contain as many ounces as advertised; and reduced-sized boxes of cereal.

Your job today is to serve as the design team for our town’s local movie theater company. Fewer people are going to the theater because of the economy, so the company needs to increase their profits in any way they can. They possess a lot of raw material for making the containers for movie popcorn (hold up 9” x 12” construction paper/grid paper). As a design team, you will create a popcorn container that will help the company maximize its profits.

Your containers will be rectangular prisms, open at the bottom and top. You may attach a bottom base if you would like, but it is not necessary. You are not

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allowed to cut – only fold. Tape so there is no overlapping (demonstrate). Fold the prisms first, and then predict which will hold the most to the least.

When you are ready for your filling material to test your predictions, I will bring it to your tables. When you are finished filling your containers, measure them to determine the numerical volume and prove or disprove what you found with the popcorn. Round your measurements to the tenth's place.

The following are questions that should be addressed during the container creation phase:

How many different containers could you make by folding the 9" x 12" paper into a rectangular prism? There are four. *Width* (left to right) x *Depth* (front to back) x *Height* (top to bottom) measurements follow –

#1. 2.25" x 2.25" x 12" = 60.8 in^3
#2. 3" x 3" x 9" = 81 in^3

#3. 4.5" x 1.5" x 9" = 60.8 in^3
#4. 3 3/8" x 1 1/8" x 12" = 45.6 in^3

How did you fold your 9" x 12" sheets to create your containers? Two of them can be folded into fourths along the 9" and 12" sides. From these two prisms, we can half each fourth to make eighths and re-fold them into different prisms.

How did your predictions compare to how much popcorn the containers really held? Answers will vary.

How did filling your prisms with popcorn help you determine the volumes of your prisms? The cup became the unit of measure.

Did it matter that the entire class did not have the same cup size with which to measure volume? No. No matter the cup size, I can determine which of my containers holds the most to the least. The smallest container will hold the least number of any sized-cup' the largest container will hold the most number of any sized-cup.

How did you determine the volume for each container? Some students will use the formula "length x width x height." Some will find the area of the base first and then multiply by the height. On the two prisms with square bases, students may use exponents to express the area of the base since the width and depth dimensions will be the same.

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If you created all four prisms, what did you notice about two of them? Two of the prisms had the same volume measurements.

#1) 2.25" x 2.25" x 12" = 60.8 in^3 <u>and</u> #3) 4.5" x 1.5" x 9" = 60.8 in^3

By changing the measurements into improper fractions, their equivalent volumes become clear.

$\frac{9"}{4} \times \frac{9"}{4} \times 12"$ versus $\frac{9"}{2} \times \frac{3"}{2} \times 9$

$\frac{81" \text{ x } 12"}{16"}$ versus $\frac{81" \text{ x } 3"}{4"}$

$\frac{12}{16} = \frac{3}{4}$ indicating that ¾ of 81 is 60.75, or the volume of both containers.

Did you predict these two prisms would hold the same amount of popcorn (If some groups did not create prism #3, show this prism to the entire class)? Explain your thinking. Answers will vary. Require that student answer with specific responses, not only "yes" or "no."

In closing the lesson, the teacher should lead a class discussion of students' findings/recommendations for local movie theater company. Record each group's recommendations on the board; similar responses should be tallied.

Which container did your group recommend our local theater company use? If students constructed only prisms #1 and #2, the prism (#1) with a volume of 60.8 in^3 should be selected. If students created all four prisms, prism #4 holds the least amount of popcorn (45.6in^3). The container that holds the least would help the company maximize its profit if the charge for the new container stayed the same as the current price of a larger container (i.e. minimizing volume maximizes profit).

The teacher may want to discuss how to maximize volume of a rectangular prism, in general. A cube is the largest volume. However, if the given dimensions do not produce a cube, then the largest volume will result from dimensions that are as close to a cube as possible. For example, a 3 x 3 x 4 might be the closest dimensions to a cube.

Do you think consumers would easily accept a change from a larger popcorn container to prism #4? Answers will vary. However, prism #4 is very

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small, and consumers may complain about its size. Students may want to consider consumer buying habits and how companies have to please their customers to a certain extent to guarantee their patronage.

Of prism #1 and #3, which one do you think customers would feel held more? Answers will vary. Encourage students to articulate their thoughts about the dimensions of both prisms (i.e. taller versus shorter; narrower versus wider; deeper versus shallower) and how they affect perception of volume.

Based on our discussion, have you changed your mind about which container you will recommend that the company produce? Answers will vary.

Learn More:

http://money.msn.com/shopping-deals/scam-alert-same-price-less-product-marketwatch.aspx
Article #1

http://www.kpsplocal2.com/news/local/story/Grocery-Items-Coming-in-Smaller-Packages-Same/95ys1dZ2hUascpgaC5-udQ.cspx?rss=2276
Article #2

http://www.kjrh.com/dpp/news/segment_2/grocery-store-products-shrinking-while-prices-stay-the-same%3F--
Video Clip at 2:02 minutes

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Name: ________________
Name of partner(s): ____________________

Movie Theater Design Team – Worksheet 1

The local theater is losing money. Because of the economy, less people are going to movies. The theater has hired your company to create a new popcorn container – one that will make the theater the most money. The company will not reduce the price of the new container even though it will hold less popcorn.

The company owns a lot of the material that they currently use to make popcorn containers. They want your team to design a rectangular prism container that will look similar to the bags the company currently uses. Recommend a container size with dimensions that will help maximize company profits. Be able to explain your decision.

<u>Your materials:</u>

9 x 12 construction paper OR inch grid paper
tape
pencil
rulers
calculators
popcorn
cup for scooping popcorn
clean sheet of paper to put containers on when filling with popcorn
markers or colored pencils (optional)

<u>Design Guidelines:</u>

- You may not cut your construction paper.
- Your container must be taped without overlapping.
- When you finish all requirements, you may decorate your container.

Designing a Movie Popcorn Container – Worksheet 2

Name: ___________________________
Name(s) of Partner(s):____

Directions: Answer the questions below in complete sentences. You may use a calculator. **Show all work.** You may use the back, also.

1. **What are the dimensions of your containers?**

   Length (left to right)   Depth (front to back)   Height (top to bottom)

2. **Draw sketches of your containers.**

3. **What are the volumes of each of your containers?**

4. **Which container will maximize profit? Make a recommendation to the movie theater company. Explain your thinking. Use correct mathematical language.**