

Rich Mathematical Task – Grade 7 – *Designing a Shipping Box filled with Candy*

Task Overview/Description/Purpose:	
<ul style="list-style-type: none"> The purpose of this task is to deepen student understanding of solving practical problems involving surface area and volume. In this task, students will design a shipping box that will contain cylinder shaped candy containers. 	
Standards Alignment: Strand – Number and Number Sense	
<p>Primary SOL: 7.4 The student will a) describe and determine the volume and surface area of rectangular prisms and cylinders; and b) solve problems, including practical problems, involving the volume and surface area of rectangular prisms and cylinders.</p> <p>Related SOL (within or across grade levels/courses): 5.8, 6.7, 7.11, 8.6, and 8.10</p>	
<p>Learning Intention(s):</p> <ul style="list-style-type: none"> Content - I am learning to determine the volume and surface area of rectangular prisms and cylinders. Language - I am learning to explain my problem-solving approach verbally and in writing. Social - I am learning to explain my problem-solving thinking to my peers. 	
<p>Success Criteria (Evidence of Student Learning):</p> <ul style="list-style-type: none"> I can determine if a practical problem involving a rectangular prism or cylinder represents the application of volume or surface area. I can solve practical problems that require determining the surface area or volume of rectangular prisms and cylinders. I can work with 2- and 3-dimensional shapes to solve a problem involving volume and surface area. I can communicate my reasoning clearly. I can effectively communicate my problem solving to peers as we work to determine which shipping box is the most efficient in terms of the amount of material used. 	
Mathematics Process Goals	
Problem Solving	<ul style="list-style-type: none"> Students will choose an appropriate problem-solving strategy or strategies to determine if a practical problem represents the application of volume or surface area. Students will apply their knowledge of surface area and volume of rectangular prisms and cylinders to solve practical problems.
Communication and Reasoning	<ul style="list-style-type: none"> Students will justify their solutions verbally and with mathematical evidence. Students will communicate the outcomes in a practical situation and support their thinking with evidence.
Connections and Representations	<ul style="list-style-type: none"> Students will make mathematical connections between volume and surface area of 3-dimensional figures with area of 2 dimensional figures. Students will represent and describe mathematical ideas using a variety of methods such as visuals and mathematical calculations.
Task Pre-Planning	
Approximate Length/Time Frame: 45 minutes	

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Task Pre-Planning	
Grouping of Students: <ul style="list-style-type: none">• Large group: Set the stage through a series of questions. Be sure that vocabulary has been presented in previous lessons. Set expectations for each part of the task. Present task.• Independent Think Time: Allow students 2 minutes to think about the task without writing.• Shoulder Partners: Allow students 2 minutes to share their ideas of how to approach the problem.• Independent: Complete task.• Large Group: In the closing, consider ways to ensure that each student will have an equitable opportunity to share his/her thinking during task discussion. Select individuals to share their strategies.	
Materials and Technology: <ul style="list-style-type: none">• Copies of task• Calculators• Graph paper• Isometric dot paper• Copy of a net of a rectangular prism (included in the possible graphic organizers)	Vocabulary: <ul style="list-style-type: none">• Surface area• Volume• Net• Rectangular prism• Cylinder• Base• Faces• Height• Width• Dimension
Anticipate Responses: See the Planning for Mathematical Discourse Chart (columns 1-3).	

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Task Implementation (Before)

Task Launch:

- Tell the story of the Colorful Candy Company’s wish to design a box that holds a certain number of containers of candy.
 - The Colorful Candy Company packages its most popular candy in small cylindrical cans.
 - There are several grocery stores that are excited to sale the company’s candy in their store so that have requested large orders to be shipped to their stores.
 - The Colorful Candy Company must design an economical shipping box. They have decided to ship the cylinder candy containers in boxes shaped like rectangular prisms.
- Introduce the task and help students to understand what the task is asking them to do.
 - Today, you are going to design a shipping box that will contain some candy containers.
 - There are many ways to tackle the problem and there is more than one right answer. You are to decide on how to solve this problem.
 - Read through the task carefully and answer the questions. Make sure you record all your reasoning carefully and explain all your decisions
- As a whole group, the teacher will introduce the task using a reading strategy (Three Read Protocol) to ensure all students understand what the problem is asking and the vocabulary that is used in the task.
 - First read: Students focus on what the situation is about. Teacher debrief providing clarity to the problem and addressing vocabulary questions.
 - Second read: Students identify what the quantities are in the situation. Teacher debriefs.
 - Third read: Students identify the mathematical question being asked of this situation. Teacher debriefs.
- Provide 2 minutes of independent think time for students without writing.
- Provide 2 minutes for shoulder partners to share their ideas without writing.
- Clarify any questions and provide approximately 15 – 20 minutes for students to complete the task independently.

Task Implementation (During)

Directions for Supporting Implementation of the Task

- Monitor – The teacher will observe students as they work independently on the task. The teacher will engage with students by asking assessing or advancing questions, as necessary.
- Select – The teacher will decide which strategies or thinking (how they matched the Store to the relative box plot) that will be highlighted (after implementation) that will advance mathematical ideas and support student learning.
- Sequence – The teacher will decide the order in which student ideas will be highlighted during the closure discussion (after implementation).
- Connect – The teacher will consider ways to facilitate connections between different student responses.

Suggestions for Additional Student Support

- For students with visual-motor weaknesses, have resources such as graph paper and isometric dot paper available to help explore drawing nets of rectangular prisms and/or three-dimensional rectangular prisms, or provide a copy of the net of a rectangular prism (see possible graphic organizers section of template).
- Students with challenges in memory and language could benefit from word walls or graphic organizers to activate prior knowledge about vocabulary and strategies for calculating surface area and volume.

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- Some students get stuck at one way of thinking and using one method. Asking questions like “How confident are you?” and “What would convince someone?” will help students get past this point.
- For students with motor processing difficulties, allow them to communicate the reasoning in other ways such as video recording or typing answers.
- For students with attention challenges ask student to restate the problem or important information.
- Provide manipulatives such as centimeter cubes and nets of various 3 dimensional figures.
- For students who need more support in justifying their thinking, you may choose to provide them with the sentence frames below.
 - What I know about volume/surface area is ...
 - The difference between volume and surface area is....
 - My method for solving the problem was...
- For ELs with first language literacy, try to provide prompt, or parts of prompt, in their home language

Task Implementation (After) 20 minutes

Connecting Student Responses (From Anticipating Student Response Chart) and Closure of the Task:

- Based on the actual student responses, sequence and select particular students to present their mathematical work during class discussion.
- Connect different students’ responses and connect the responses to the key mathematical ideas to bring closure to the task.
- Lead the class discourse to identify the similarities and differences between the drawings of the rectangular prisms (nets and 3-dimensional figures)
- Have students share their answer to the second question and explain how they made their comparisons and or decisions in the third question.
- During the discussion, ask students to explain the meaning of any terminology they use.
- For each question, ensure students are providing evidence to support their explanations.
- Consider ways to ensure that each student will have an equitable opportunity to share his/her thinking during task discussion. For instance, provide the students whose work was not selected as part of the sequence of student work that will be shown the opportunity to validate and/or question what they see.

Teacher Reflection About Student Learning:

- Were the instructional objectives met? Were the students able to apply strategies for determining volume and surface area?
- Were the process goal objectives met? Were students able to explain their work verbally (oral or written)? Does vocabulary need further development?
- Were the students productively engaged?
- Was enough support provided during the task using the chart of anticipated responses? Did additional responses occur that were not anticipated?
- What strategies did the students struggle with the most? Were there reoccurring student misconceptions?
- How will the evidence provided through student work inform further instruction?
- Did the task rubric assist in identifying students who need additional support? What additional assistance and support will be needed for students who are developing or emerging?

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Planning for Mathematical Discourse

Mathematical Task: Designing a Shipping Box Filled with Candy

Content Standard(s): SOL 7.4

Anticipated Student Response/Strategy <i>Provide examples of possible correct student responses along with examples of student errors/misconceptions</i>	Assessing Questions <i>Teacher questioning that allows student to explain and clarify thinking</i>	Advancing Questions <i>Teacher questioning that moves thinking forward</i>	List of Students Providing Response <i>Who? Which students used this strategy?</i>	Discussion Order - sequencing student responses <ul style="list-style-type: none"> • <i>Based on the actual student responses, sequence and select particular students to present their mathematical work during class discussion</i> • <i>Connect different students' responses and connect the responses to the key mathematical ideas</i> • <i>Consider ways to ensure that each student will have an equitable opportunity to share his/her thinking during task discussion</i>
<p>Anticipated Student Response: No approach. Student has no idea where to begin. <i>"I don't know what to do."</i></p>	<ul style="list-style-type: none"> • How would you explain the problem in your own words? • What are you trying to do? • What math have you worked on before that might help you? • What do you know? What other information do you need? 	<ul style="list-style-type: none"> • How big does the box need to be to fit 16 candy containers? • How do you determine the length, width, and height of the box? 		
<p>Anticipated Student Response: Logical Thinking Approach <i>"I just know that the answer is..."</i></p>	<ul style="list-style-type: none"> • How do you know? • Walk me through the steps. Where did you begin? • How does this help you answer the question? 	<ul style="list-style-type: none"> • Can you use a mathematical model to represent your thinking? • What math vocabulary can you use in your justification? 		
<p>Anticipated Student Response: Does not use the measurements correctly or makes error in drawing the net or prism</p>	<ul style="list-style-type: none"> • How do you know? • Walk me through the steps. Where did you begin? • How does this help you answer the question? • Imagine folding up your net. Which shape is the base? Which 	<ul style="list-style-type: none"> • Can you think of another way to justify your solutions? • What math vocabulary can you use in your justification? 		

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	shapes are the faces? Which shape is the top? <ul style="list-style-type: none"> • Does your net fold to make a rectangular prism? • What are the planned dimensions for the box? 			
Anticipated Student Response: Creates only one design	<ul style="list-style-type: none"> • How do you know that your model is a correct model? • Walk me through the steps. Where did you begin? 	<ul style="list-style-type: none"> • Can you find a different way of packing the candy containers together closely? • Can you find a better design? 		
Anticipated Student Response: Does not justify assumptions about packing the candy containers or provides inadequate justifications.	<ul style="list-style-type: none"> • What are your dimensions of your box? How did you determine this? • Which way of packing the candies have you chosen? Why? • What features would make one box better than another? Why? 	<ul style="list-style-type: none"> • Can you find a different way of packing the candy containers together closely? • Can you find a better design? • Can you find a box that requires less cardboard? 		

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NAME _____ DATE _____

Designing a Shipping Box Filled with Candy

A candy company wants you to design a shipping box that will contain 16 candy containers.

Your design must consider the following:



- The candy container is a cylinder that is 8 inches tall and 3 inches in diameter.
 - The needed shipping box must be made in the form of a rectangular prism.
- A.** Draw a picture of your shipping box with its labeled dimensions. Explain how you determined your dimensions.
- B.** Determine the amount of cardboard needed to make your shipping box. Explain how you determined your answer.
- C.** Compare your shipping box with a classmate's shipping box that is different. Decide which shipping container is the most efficient in terms of the amount of cardboard needed?

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Rich Mathematical Task Rubric

	Advanced	Proficient	Developing	Emerging
Mathematical Understanding	<p>Proficient Plus:</p> <ul style="list-style-type: none"> Uses relationships among mathematical concepts or makes mathematical generalizations 	<ul style="list-style-type: none"> Demonstrates an understanding of concepts and skills associated with task Applies mathematical concepts and skills which lead to a valid and correct solution 	<ul style="list-style-type: none"> Demonstrates a partial understanding of concepts and skills associated with task Applies mathematical concepts and skills which lead to an incomplete or incorrect solution 	<ul style="list-style-type: none"> Demonstrates no understanding of concepts and skills associated with task Applies limited mathematical concepts and skills in an attempt to find a solution or provides no solution
Problem Solving	<p>Proficient Plus:</p> <ul style="list-style-type: none"> Problem solving strategy is well developed or efficient 	<ul style="list-style-type: none"> Problem solving strategy displays an understanding of the underlying mathematical concept Produces a solution relevant to the problem and confirms the reasonableness of the solution 	<ul style="list-style-type: none"> Problem solving strategy displays a limited understanding of the underlying mathematical concept Produces a solution relevant to the problem but does not confirm the reasonableness of the solution 	<ul style="list-style-type: none"> A problem solving strategy is not evident Does not produce a solution that is relevant to the problem
Communication and Reasoning	<p>Proficient Plus:</p> <ul style="list-style-type: none"> Reasoning or justification is comprehensive Consistently uses precise mathematical language to communicate thinking 	<ul style="list-style-type: none"> Demonstrates reasoning and/or justifies solution steps Supports arguments and claims with evidence Uses mathematical language to communicate thinking 	<ul style="list-style-type: none"> Reasoning or justification of solution steps is limited or contains misconceptions Provides limited or inconsistent evidence to support arguments and claims Uses limited mathematical language to partially communicate thinking 	<ul style="list-style-type: none"> Provides no correct reasoning or justification Does not provide evidence to support arguments and claims Uses no mathematical language to communicate thinking
Representations and Connections	<p>Proficient Plus:</p> <ul style="list-style-type: none"> Uses representations to analyze relationships and extend thinking Uses mathematical connections to extend the solution to other mathematics or to deepen understanding 	<ul style="list-style-type: none"> Uses a representation or multiple representations, with accurate labels, to explore and model the problem Makes a mathematical connection that is relevant to the context of the problem 	<ul style="list-style-type: none"> Uses an incomplete or limited representation to model the problem Makes a partial mathematical connection or the connection is not relevant to the context of the problem 	<ul style="list-style-type: none"> Uses no representation or uses a representation that does not model the problem Makes no mathematical connections

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Possible Graphic Organizers

