

<b>Lesson Title: Surface Area, Volume, Capacity Problem Solving</b>		<b>Pre 8.5</b>
<b>Utah State Core Standard and Indicators</b> Pre-algebra Standard 4. Process Standards 1-5		
<b>Summary</b>		
In this lesson, students examine how to find the surface area of a box. Then they learn how to find the volume of the contents of the box. They create different boxes by cutting out the corners of a piece of graph paper. They look at maximum volume as related to height.		
<p style="text-align: center;"><b>Enduring Understanding</b></p> <ul style="list-style-type: none"> <li>Solving problems enables us to make comparisons and connections about perimeter and area as related to volume and surface area.</li> <li>We can develop our understanding and practical application of volume and surface area concepts as we solve problems that relate to the real world.</li> </ul>	<p style="text-align: center;"><b>Essential Questions</b></p> <p>How do we measure 3D shapes, that is geometric solids?</p>	
<p style="text-align: center;"><b>Skill Focus</b></p> <ul style="list-style-type: none"> <li>Maximum volume as related to surface area, rectangular prisms and cylinders.</li> <li>Irregular surface area</li> </ul>	<p style="text-align: center;"><b>Vocabulary Focus</b></p>	
<b>Assessment</b>		
<b>Materials:</b> Graph paper, scissors, cereal box, different kinds of containers, materials such as fabric to help estimate skin surface area		
<b>Launch</b>		
<p><b>Explore</b></p> <ul style="list-style-type: none"> <li>Think about your findings in “Building a fence for Fido.” What kind of box do you predict might hold the most and take the least amount of cardboard?</li> <li>How do you find the volume of a box? A can?</li> <li>Would a can hold more than a box? Why or why not?</li> <li>What strategies would you use to determine the surface area of your skin?</li> </ul>		
<b>Summarize</b>		
<b>Apply</b>		

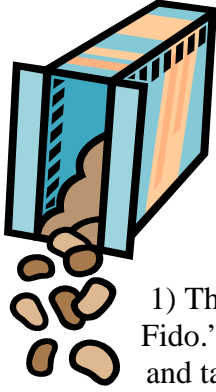
**Directions:**

In Pre 7.9a, Packing the Packages, help students generate the formula for the volume rectangular prism as the area of the base \* height. Then help them transfer that formula to the volume of a cylinder. (They should know how to find the area of the base of a cylinder.) *Have students present their thinking and strategies and conclusions.*

For Pre 7.9 assessment, How Much Skin Do You Have?, *allow students freedom to come up with their own strategies and then share their processes and solutions.*

## Pre 8.5

## Packing the Packages



Did you ever notice that cereal comes in tall, thin boxes and that laundry soap comes in short, wide boxes? Why do you think they come as they do?

1) Think about your findings in “Building a fence for Fido.” What kind of box do you predict might hold the and take the least amount of cardboard?



most

- 2) We called the perimeter of a polygon a fence. What are some other words or ideas which might describe the edge of a polygon or circle?

How can you describe the area of a polygon or circle?

- 3) What are some words or ideas which could be used to describe the surface of a box?

How would you describe what goes inside a box?

- 4) Suppose your favorite cereal comes in a box that is 24 cm. high, 20 cm. long, and 6 cm. wide. Sketch the parts below. Label the dimensions.

Box bottom

Box front

Box side

5) Draw a net for your cereal box. Use graph paper.

6) This opened up box shows the surface area of your box. Find the following areas:  
Show your work.

The bottom of your box. \_\_\_\_\_

The front of your box. \_\_\_\_\_

The side of your box. \_\_\_\_\_

The total surface area of your box. \_\_\_\_\_

7) Now lets investigate the kind of box which would hold the most and use the least amount of packaging.

- Take a piece of centimeter graph paper. (Cut off the edges if necessary so that every square is a full centimeter wide.)
- Cut out one centimeter from each corner. Then fold up the strips left on each edge and tape to make a 1 cm. tall flat box. How many square centimeters could fill this box? Record the information below. (Assume that the box would have a top even though the model doesn't.)
- Now increase the cutout from the corner to become 2 cm by 2 cm wide. Fold up the sides to be 2 cm high. Record the information. Continue the pattern. (Please note that you are cutting away material—this would be considered wasted. Perhaps amount of waste is also a consideration when deciding on the shapes of boxes.)

Length														
Width														
Height	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Surface Area														
Volume														

Circle the Box dimensions above which give the maximum volume and minimum surface area. Write your ideas below regarding efficient box shapes. Relate back to your prediction and the data above.

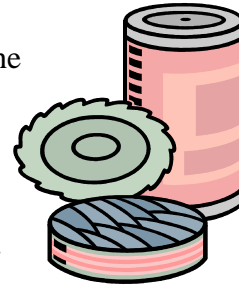
8) The formula for finding volume of a right rectangular prism is  $V = LWH$ . Explain this formula.

9) Considering what you learned above, why do you think cold cereal makers choose the box shapes they do?

10) Because a cubic cm. of a solid is equal to \_\_\_\_\_ml of water, you can transfer from volume to capacity easily in metrics. If your most efficient box from question 6 above could hold water, how much water would there be? \_\_\_\_\_

11) Now lets look at soup or tuna fish cans. Why are soup cans tall and tuna cans short?

- What kind of can would you predict to hold the most and use the least amount of packaging?
- To find out how to create a net for a cylinder, use an empty paper towel or toilet paper roll. Cut the roll from top to bottom. Open it out. What shape is it? \_\_\_\_\_



- Now create a net for a soup can. Use graph paper. What measurements do you need?  
 \_\_\_\_\_
- Find the measurements. Show all work. \_\_\_\_\_

12) Use your knowledge of box volume to figure out a formula for finding the volume of a cylinder.  $V(\text{cylinder}) =$  \_\_\_\_\_

13) Find the following. Show all work.	Surface areas:	Volumes::
Soup Can	_____	_____
Tuna Can	_____	_____

14) Why do you think companies choose the cans they do?

## **Pre 8.5 assessment**

### **How Much Skin do You Have?**

**Estimate the area covered by the skin on your body.**

**Show all work and draw pictures to go with the work.**