

Surface Area and Volume

Strand: Two-and Three-Dimensional Figures

Topic: Solving surface area and volume problems in context

Primary SOL: **G.DF.1 The student will create models and solve problems, including those in context, involving surface area and volume of rectangular and triangular prisms, cylinders, cones, pyramids, and spheres.**

Related SOL: G.TR.4

Materials

- Solving Problems activity sheet (attached)
- Graphing utility
- Cans
- Scissors
- Boxes made of lightweight cardboard
- Oranges
- Wax paper
- Knife (to cut oranges)
- Unit cubes
- Milk cartons or other boxes of the same shape but different sizes
- Geometric shape set (hollow)
- Sand, rice, or water
- Rulers
- Graduated cylinders

Vocabulary

area of a face, base, circumference, composite figures, cone, cylinder, derive, face of a 3-D figure, formula, height, hemisphere, lateral area, length, net, perimeter, prism, pyramid, rectangular prism, regular pyramid, scale, sphere, surface area, three-dimensional, two-dimensional, volume, width

Student/Teacher Actions: What should students be doing? What should teachers be doing?

1. Discuss with students:
 - What are the formulas for determining the surface area and volume of solid figures? How can these formulas be used to solve practical problems?
 - How do the formulas for volume of a cylinder and a rectangular prism relate to one another? How might this help you to find the volume of a triangular prism? *The goal of these questions is to guide students toward the understanding that prisms and cylinders have the same basic volume formula where volume is calculated by multiplying the area of the base and the height (or distance between bases).*
 - How do the formulas for volume of a cone and a pyramid relate to one another? How might this help you to find the volume of a triangular-based pyramid? *The goal of these questions is to guide students toward the understanding that*

pyramids and cones have the same basic volume formula where volume is calculated by multiplying the area of the base and the height (or distance between bases) and dividing by 3.

2. Students will use their knowledge of surface area and volume to complete the Solving Problems activity sheet.

Assessment

- **Questions**

- List the following three-dimensional figures in order, from the figure with the least volume to the figure with the greatest volume:
 - a pyramid with a square base with sides measuring 25 centimeters and height measuring 30 centimeters
 - a sphere with radius of 10 centimeters
 - a rectangular prism measuring 10 centimeters x 20 centimeters x 30 centimeters
 - a cylinder with radius of 10 centimeters and height of 20 centimeters
- A water tank is 3 meters tall and has a diameter of 4 meters. The water level is 2 meters high. How many more cubic meters of water can be added to the tank? Justify your answer.
- A red cylinder has a diameter that is twice that of a blue cylinder. The height of the red cylinder is half that of the blue cylinder. Compare the volumes of the two cylinders. Which holds more?

- **Journal/writing prompts**

- A soup can label is printed on a rectangular piece of paper. Explain how the radius and height of the soup can are related to the length and width of the rectangular piece of paper.
- Describe a practical example that uses surface area or volume.
- Write a practical problem and solution that uses surface area or volume.

- **Other Assessments**

- Have students bring in an example of packaging that does not form a solid that the class has studied (or allow students to select from a collection you have gathered). Have them determine (or estimate) the solid's surface area and volume and explain their process and reasoning.

Extensions and Connections (for all students)

- Discuss the relationship of surface area and volume of three-dimensional solids and their relationship to area and perimeter of two-dimensional figures.
- Have students calculate the volume of various sized three-dimensional figures and then create the models in dynamic software such as GeoGebra to verify their answers.
- Have students calculate the volume of a prism with a base made of compound two-dimensional figures or a regular polygon.

Mathematics Instructional Plan – Geometry

- Create a lesson that includes mock prices of popcorn containers in various three-dimensional shapes. Ask students to analyze the best value with justification for their reasoning.
- Have students search the Internet for more nets of platonic solids and investigate their surface areas and volumes.

Strategies for Differentiation

- Use manipulatives to build figures from nets.
- Use enlarged graph paper for nets.
- Use presentation software to post multimedia classroom lectures, student conclusions, and notes online.
- Have students work in groups to make up their own review materials.
- Use presentation software to create a multimedia presentation to highlight key elements of the lesson.
- Have students use the presentation as a review at the end of the lesson.
- Using computer software, create visual representations of the formulas and figures, and randomly distribute them to students. Have students cut and paste to match the formulas to the correct figures.

Note: The following pages are intended for classroom use for students as a visual aid to learning.

3. A silo is a building used to store grain. It is cylindrical in shape with a dome (hemisphere) on top. The silo is 15 meters tall and has a diameter of 4 meters. Draw and label the silo with the provided measurements. How much grain will this silo hold? If grain is sold for \$25.00 per cubic meter, what is the value of the grain in this silo?

Suppose the farmer needs to paint the silo. Find the surface area he will need to paint. If each can of paint covers 150 square feet, how many cans will the farmer need to paint the entire silo? The bottom of the silo is not painted.

4. A candy bar comes in a package in the shape of a triangular prism as shown below.



Figure 1. Candy Bar in the shape of a triangular prism.

The triangular bases are regular triangles. The package for a 12.6 oz candy bar is approximately 12 inches long and 2.5 inches wide. How many more square inches of cardboard are needed for the packaging of the candy bar? Draw and label the candy bar with the provided measurements and use pictures and words to justify your answer.