

Module: Mathematical Reasoning

Lesson Title: Sugar Cube Condos: Determining Surface Area and Volume

Objectives and Standards

Students will:

- Use manipulatives to determine surface area and volume of a prism
- Determine the relationship between scale factor, area, and volume and identify the pattern

Mathematical Reasoning 2014 GED® Assessment Targets	Mathematical Practices 2014 GED® Assessment Targets
Compute volume and surface area of right prisms and pyramids, cylinders, spheres, cones, and composite figures. (Q.5.a, Q.5.b, Q.5.c)	Make sense of problems and persevere in solving them. (MP1) Model with mathematics. (MP4) Use appropriate tools strategically. (MP5) Look for and make use of structure. (MP7)

Materials

- Sugar cubes (approximately 100 cubes per student group)
- Measuring tapes
- Recording sheet
- Copies of either the Formula Page for the GED® test – located at:
<http://www.gedtestingservice.com/uploads/files/15a951dfbdd875be5a7a73aa7912e2a0.pdf>
 or
 The Math Formulas and Symbols Chart
<http://www.gedtestingservice.com/uploads/files/3fd9475e25b36d78af7305296c23d581.pdf>

Instructional Plan

Overview

In this lesson, students explore the relationship between scale factor, area, and volume using manipulatives.

Process

Begin the lesson by writing the formulas for surface area and volume of a rectangular/right prism on the board: $SA = ph + 2B$ and $V = Bh$. Have students discuss situations in which they may use each type of formula in their workplaces or daily lives. Explain that in today’s lesson they will be using these formulas to explore the relationship between scale factor, area, and volume.

Divide students into small groups of 3 to 4 students. Provide each group of students with a set of sugar cubes. Explain to students that they will be using the sugar cubes to build “condos.” Tell each group that you want them to build a rectangular prism (sugar cube condo) with the sugar cubes that measure 2” x 2” x 3”. Have students record measurements in a table and determine the surface area and volume of the condo. You may wish to provide students with a copy of the Formula Page for the GED Mathematics module.

Have students record these measurements in a table.

Next, direct students to build another condo with a scale factor of 2/1. Students should recognize that all original lengths should be doubled using this scale factor. Have students record the new measurements in the table and determine the surface area and volume of the new figure.

Have students build a third condo where the scale factor is 3/1 in relation to the original condo. Students should recognize that all lengths are tripled. Have students record the new measurements in the table and determine the surface area and volume of this final figure.

Have students analyze their data and determine a pattern that occurs in both the surface area and the volume when increasing the scale factor.

Sample Debriefing Questions

- What would the surface area be for a sugar cube condo if the scale factor were 4/1?
- What would the volume be for a sugar cube condo if the scale factor were 4/1?
- What pattern occurs when increasing the scale factor for surface area?
- What pattern occurs when increasing the scale factor for volume?
- How would you determine surface area and volume if the scale factor were 10/1? 15/1?

Assessments/Extensions

1. Provide students with a specific volume and see if they come up with possible surface areas. For example, a rectangular prism with a volume of 180 cubic units might have dimensions of 6 by 5 by 3 or 30 by 3 by 2. Have students explain how different possibilities of dimension affect surface area.
2. Have students solve real-world word problems that assess their knowledge of surface area and volume. You may wish to create samples or use sample problems from texts or the World Wide Web.

Sample Problems

- Ariel bought a large cube of bird feed to put out in her backyard for all the beautiful birds. One side of the cube has an area of 9 square inches. What is the volume of the cube? (27 cubic inches)
- Charlie’s favorite snack is Crunch and Munch. He buys a big box for a special treat and wants to figure out exactly how much of his sweet and salty snack is in the box. The box has a base area of 18 square inches, and the height is 2 feet. How many cubic inches of snack fills the box? (432 cubic inches)
- A local movie theatre is deciding whether they will serve popcorn in a bucket or in a box. The bucket is a cylinder with a radius of 2 inches and a height of 7 inches. The box is a rectangular prism with a length of 4 inches, width of 2 inches, and height of 11 inches. What

is the surface area and volume of both containers? If you were the theatre owner, how would you determine which package to use? Provide reasons for your answer.

3. Provide students with the box in which the sugar cubes were contained. Have students measure the box and a single sugar cube. Have students predict how many sugar cubes it would take to fill the box. Have students check their predictions by using the correct formula for volume and then checking their answer by “filling” the box. Extend the lesson by asking students the following types of questions:
 - If the sugar company decided to decrease the size of the sugar cubes and make them $\frac{1}{2}$ in. on all sides, how many $\frac{1}{2}$ in. sugar cubes would it take to fill the box?
 - The sugar cube company packs 36 boxes in cases to ship to stores. You have been assigned the task of determining the dimensions of a case that will hold 36 boxes. Determine the dimensions and explain how you arrived at your answer.

Recording Sheet

Scale	Measurement			Surface Area	Volume
	Length	Height	Width		
1/1					