

The Value of Volume

Strand: Measurement

3-4 Benchmark:

- D. Identify appropriate tools and apply counting techniques for measuring side lengths, perimeter and area of squares, rectangles, and simple irregular two-dimensional shapes, volume of rectangular prisms, and time and temperature.

5-7 Benchmark:

- C. Identify appropriate tools and apply appropriate techniques for measuring angles, perimeter or circumference and area of triangles, quadrilaterals, circles and composite shapes, and surface area and volume of prisms and cylinders.

8-10 Benchmark:

- B. Use formulas to find surface area and volume for specified three-dimensional objects accurate to a specified level of precision.
- C. Apply indirect measurement techniques, tools and formulas, as, to find perimeter, circumference and area of circles, triangles, quadrilaterals and composite shapes, and to find volume of prisms, cylinders, and pyramids.

Supplies: Hollow geometric solids
Chart
Rice or water
Graduated Cylinder

Procedure:

1. First let's identify the geometric solids and describe them based on their characteristics. For example, a cube is a rectangular prism with 6 congruent square faces. Hold up a solid, have students name it and tell characteristics of it. Characteristics include:

Cube - 6 congruent square faces

Square Pyramid - 5 faces, 1 square base, 4 triangular lateral faces

Triangular Prism - 5 faces, 2 triangle bases, 3 rectangle faces

Triangular Pyramid - 4 faces, 1 triangle base, 3 triangular lateral faces

Cylinder - 0 faces, 2 circular bases

Cone - 0 faces, 1 circular base

Rectangular Prism - 2 square or rectangle bases, 4 rectangle faces

Sphere - set of all points an equal distance from a given point or center

Hemisphere - half of a sphere

Pentagonal Prism - 2 pentagon bases, 5 rectangle faces

2. These solids are going to help us study volume. Volume is the number of cubic units needed to fill a given space. What are some different ways to find volume?

3. Let's see how many base 10 blocks, measuring 1 cc each, it takes to make one row along an inside edge. (5) Assume that the left over space is .5 block making the measurement 5.5. Now let's make a row perpendicular to that row. How many blocks did it take? (5). Assume the left over space is .5 block making the measurement 5.5. Based on this information, can you tell the area of the bottom face? (Yes) How? (By multiplying $l \times w$ which equals 30.25) Now fill the bottom and see if you are correct. $25 + 10$ half blocks and a one-fourth block in the corner = 30.25. Now that we found the area of the base, let's find the volume by completely filling the

cube with base 10 blocks. Go ahead and assume the empty space is .5 block. How many did it take? (166.375 cc) How can we calculate the volume using a formula? By multiplying the height of the cubes (5.5) by the area of the base (30.25). Again, we find the volume is 166.375 cc.

Explain the method being used for measuring volume: fill the solid with rice or water by first putting the measuring substance into a graduated cylinder, record the amount in the cylinder. Then pour it into the solid and repeat the process until the cube is filled. Total the amounts needed to fill the cube and record. This will be the volume. Approximate volume using rice = 155 cc. Return rice or water to its original container. (Note: 1cc = 1ml, 5cc \approx 1 tsp.)

Now let's find the volume of the cube another way. Use a ruler to measure, as best you can, the inside dimensions of the cube by measuring from dark shaded line to dark shaded line on the sides. Calculate the volume using $l \times w \times h$. (Approximate length of each side is 5.5 cm).
 $V = l \times w \times h = 5.5 \times 5.5 \times 5.5 = 166.375 \text{ cc}$

We've found that using base 10 blocks, the volume is 166.375 cc.

Using rice the volume is about 155 cc.

Using measurements and a formula the volume is 166.375 cc.

Do you agree that using rice is a fairly accurate estimate of the volume of the solids?

4. Repeat the process using a dry measurement (rice) or water to find the volume of the remaining solids. *Using rice the approximate volume of each solid should be as follows:

- large cube 155 cc
- square pyramid 55cc
- large triangular prism 83cc
- triangular pyramid 27 cc
- large cylinder 130 cc
- cone 44 cc
- small rectangular prism 41 cc
- small triangular prism 20 cc
- sphere 87 cc
- hemisphere 44 cc
- small cylinder 32 cc
- small cube 21 cc
- large rectangular prism 83 cc
- pentagonal prism 92 cc

Compare the bases of the cube and the square pyramid. You'll find that they are congruent. Compare their heights. Again, you'll find that they are the same. When looking at the volumes of these 2 solids that have the same base and height, what relationship do you see? (the volume of the cube is roughly 3 times greater than the volume of the square pyramid) This means that the square pyramid is what part (fraction) of the cube? (one-third) .

Is the same true when comparing the cylinder and the cone? How about the triangular pyramid and triangular prism?

What would be the difference if we use a liquid as our measuring substance? (there would be no empty spaces, so the volumes would be much more accurate than using rice)

Name _____

1. Measure and chart the volume of each object.

Geometric Solid	Volume using dry measure	Volume using ruler and formula
A. Large Cube		
B. Square Pyramid		
C. Triangular Prism		
D. Triangular Pyramid		
E. Large Cylinder		
F. Cone		
G. Small Rectangular Prism		
H. Small Triangular Prism		
I. Sphere		
J. Hemisphere		
K. Small Cylinder		
L. Small Cube		
M. Large Rectangular Prism		
N. Pentagonal Prism		

2. Looking at the volume results, what is the relationship between objects with congruent bases and equal heights (cube & square pyramid) (triangular prism & triangular pyramid) (cylinder & cone)?

Comparing Volume and Surface Area of 3-Dimensional Polyhedra

Name _____

Name of Polyhedron	Surface Area In Square Centimeters	Volume In Cubic Centimeters
Cube		
Rectangular Prism		
Triangular Prism		
Hexagonal Prism		
Square Pyramid		
Triangular Pyramid		
Cylinder		
Cone		