

# Build a Box

## Overview

This lesson will focus on finding the Surface Area and Volume of a rectangular prism.

## Benchmarks

### 3-4<sup>th</sup> Grade

Number, Number Sense and Operations

L. Use a variety of methods and appropriate tools (mental math, paper and pencil, calculators) for computing with whole numbers.

Measurement

A. Select appropriate units for perimeter, area, weight, volume(capacity), time and temperature, using:

\* U.S. Customary units; e.g. mile, square inch, cubic inch, second, degree Fahrenheit, and other units as appropriate;

\* metric units; e.g. millimeter, kilometer, square centimeter, kilogram, cubic Celsius, and other units as appropriate.

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

Mathematical Processes

F. Recognize relationships among different topics within mathematics; e.g. the length of an object can be represented by a number.

I. Represent problem situations in a variety of forms (physical model, diagram, in words or symbols), and recognize when some ways of representing a problem may be more helpful than others.

### 5-7<sup>th</sup> Grade

Measurement

A. Select appropriate units to measure angles, circumference, surface area, mass and volume, using:

\* U.S. Customary units; e.g. degrees, square feet, pounds, and other units as appropriate;

\* metric units; e.g. square meters, kilograms and other units as appropriate.

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.

E. Use problem solving techniques and technology as needed to solve problems involving length, weight, perimeter, area, volume, time and temperature.

F. Analyze and explain what happens to area and perimeter or surface area and volume when the dimensions of an object are changed.

G. Understand and demonstrate the independence of perimeter and area of two-dimensional shapes and of surface area and volume for three-dimensional shapes.

## 8-10<sup>th</sup> Grade

### Measurement

- B. Use formulas to find surface area and volume for specified three-dimensional objects accurate to a specific level of precision.
- C. Apply indirect measurement techniques, tools and formulas, as appropriate, to find perimeter, circumference and area of circles, triangles, quadrilaterals and composite shapes, and to find volume of prisms, cylinders, and pyramids.
- E. Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.

### Mathematical Processes

- A. Formulate a problem or mathematical model in response to a specified need or situation, determine information required to solve the problem, choose method for obtaining this information, and set limits for acceptable solution.
- F. Use precise mathematical language and notations to represent problem situations and mathematical ideas.

### Time

2 blocks (80 min.)

## Materials

Students will need the following: 2 sheets of paper (9 x 12 construction paper or 8 ½ x 11 copy paper) scissors, tape, ruler/measuring tape, calculator, graphing paper (for extension activity), graphing calculator (if available for extension activity)

## Procedure

1. Students are to work in groups of two. Each group needs 2 sheets of paper, scissors, tape, ruler/measuring tape, and calculator.
2. One person from each group will draw a measurement from a bag or box. The measurement will determine the size of square that will be cut from each corner of the 2 sheets of paper.
3. Cut out the square from each corner of the 2 sheets of construction paper. (Every group will cut out a different size square from the corners.)
4. Fold up the remaining paper to create a box without a lid. The second sheet of paper is used to make the lid.
5. Measure the length of the paper along the fold and label the length in centimeters. Measure and label the section cut out.

6. Measure the width of the paper along the fold and label the width in centimeters. Measure and label the section cut out.
7. Label each side/face/flap with a different capital letter.
8. Find the area of each side/face/flap (top, bottom, left, right, front, and back) and label the area in the center of each face next to the capital letter.
9. Tape the corners to make the box. Tape both sheets of paper so that you have a box and a lid.
10. Record on the data sheet the Surface Area of the box with a lid. (Add the areas of each face together to get Surface Area.) Be sure to label with  $\text{cm}^2$ .
11. Record on the data sheet the Volume of the box with a lid. (Multiply the length, width, and height together to get Volume.) Be sure to label with  $\text{cm}^3$ .
12. Line up the boxes in order from smallest to largest. To do this, you will have to discuss what to consider when determining smallest to largest. For example, you may want students to consider the lengths or widths (shortest to longest), surface area (least to greatest), and volume (least to greatest).
13. Lead a class discussion on the criteria used to determine this order. Discuss what they noticed happens to the order when you choose to rearrange the boxes according to another criteria.

### **Extension #1**

Students will need graphing paper or graphing calculator (if available).

1. Line up the boxes created from smallest to largest.
2. Use the data sheets to record in ascending order Surface Area. You can do the same for Volume.
3. Use graphing paper or graphing calculator to graph the list of Surface Areas by Volume.

### **Extension #2**

1. Line up the boxes created from smallest to largest.
2. Students will find the mean, median, range of the Surface Areas of the boxes.
3. Students will find the mean, median, range of the Volume of the boxes.

### **Extension #3**

1. Line up the boxes created from smallest to largest.
2. Students will find the median, upper quartile, lower quartile, lower extreme, upper extreme, interquartile range, outlier test, and any outliers of the Surface Areas and of the Volumes.
3. Using this data, students will create a box and whisker plot for the Surface Areas and for the Volumes.
4. Students will compare the two plots.

Also available.

1. Pre-Assessment
2. Post-Assessment

Build a Box  
Data Sheet

Name \_\_\_\_\_

**Surface Area**

Complete the table below.

Capital letter used for each side	Area of each side with label

Total Surface Area (label) \_\_\_\_\_

How did you find the total Surface Area? \_\_\_\_\_  
\_\_\_\_\_

**Volume**

Complete the table below.

Dimension	Measurement with label
Length	
Width	
Height	

Total Volume (label) \_\_\_\_\_

How did you find the volume? \_\_\_\_\_  
\_\_\_\_\_



Build a Box  
Post-Assessment

Name \_\_\_\_\_

1. Find the surface area of a rectangular prism that has the following dimensions. Show your work. Be sure to label.

Length = 12 mm

Width = 8 mm

Height = 15 mm

2. Find the volume of a rectangular prism that has the following dimensions. Show your work. Be sure to label.

Length = 16 in.

Width = 10 in.

Height = 8 in.