NVACS: Measurement and Data

Measurement, Line Plots, and Volume

Concept Overview for 5th Graders

5.MD.1

Convert like measurement unit within a given measurement system.

Convert among different sized-standard measurement units within a given measurement system (e.g. convert 5cm to 0.05 m), and use these conversions in solving multi-step, real world problems.

5.MD.2

Represent and Interpret data.

Make a line plot to display a data set of measurements in fractions of a unit (1/2, ¼, 1/8). Use operations on fractions for this grade to solve problems involving information presented in line plots.

5.MD.3,4,5

Geometric Measurement: Understand concepts of volume and relate volume to multiplication and to addition.

Students recognize volume as an attribute of three-dimensional space. They understand that volume can be measured by finding the total number of same-size units of volume required to fill the space without gaps or overlaps. They understand that a 1-unit by 1-unit cube is the standard unit for measuring volume. They select appropriate units, strategies, and tools for solving problems that involve estimating and measuring volumes to solve real world and mathematical problems.

Convert like measurement unit within a given measurement system.

In fifth grade students will convert within a given system for length, mass, volume, time, and money. The base ten number system understanding can help students convert units of measurement within the metric system and that connection should be made for students during instruction.

   Metric Measurement Example: 5cm = 0.05m

   US System (Customary) of Measurement Example: 6 in = 0.5 ft.

   Time: 60 minutes= 1 hour

Use these conversions to solve Multiple-Step Real World Problems.

Example 1:

Mark spent a fifth of her money on lunch. She then spent half of what remained. She bought a card game for $3, a book for $8.50, and a candy bar for 90 cents. How much money did she have at first?

Example 2:

Kelly had 175 feet of ribbon. If each of the 36 students in her class gets an equal length of ribbon, how long will each piece be if

...using only feet?
...using only feet and whole number of inches?
...using only minutes?

Represent and Interpret Data

The intention of this standard is to provide students a context for using fractions by measuring lengths to one-eighth of a unit and plotting them on a line plot. Students will use the fraction line plot data to solve computation using all four operations. See fraction section for 5th grade for more details on fraction computation at the 5th grade level. (5.NF)

Example of Computation:

Use multiplication to figure out if the total measurement of 3/8 is equal to, less than, or greater than the total measurement of 4/8. Now subtract and find the exact difference.
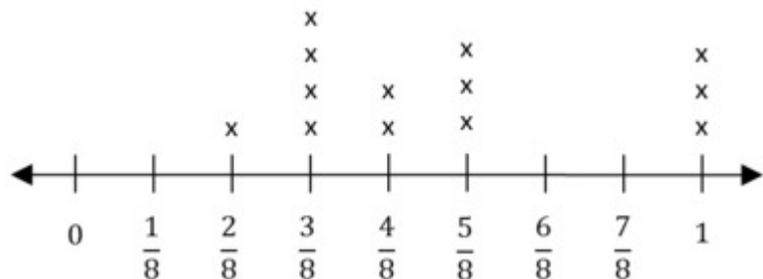
Example Question: 3/8 x 4 = a, 4/8 x 2 = b   Are they equal? Is one greater than the other? Is one less than the other? Can you find the exact difference?

Solution:

3/8 x 4 = 12/8 = 1 ½

4/8 x 2 = 1

Are they equal? Greater than? Or less than each other? 1 ½ is greater than 1.

Can you find the exact difference? The difference is ½.

Understand Concepts of Volume and relate volume to multiplication and to addition.

In 5th grade students recognize volume as an attribute of solid figures and understand concepts of volume measurement.

A cube with a length of 1 unit, called a "unit cube", is said to have a "one cubic unit" of volume, and can be used to measure volume.

A solid figure that can be packed without gaps or overlaps using *n* unit cubes is said to have a volume of *n* cubic units.

When figuring out the volume of solid figures students need to relate the concept to multiplication and addition. In 3rd grade students began working with area and covering spaces. In fifth grade the students can build on this concept and start with the bottom layer and add layers to count the total, "cubic units".
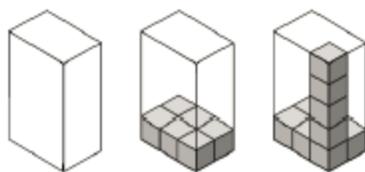
Empty Rectangular Prism

Bottom layer with 3 x 2 "cubic units" for a total of 6.

Five layers of 6 cubic units fill the box.

(3 x 2) represented by first layer

(3 x 2) x 5 represented by number of (3 x 2) layers

(3 x 2) + (3 x 2) + (3 x 2) + (3 x 2) + (3 x 2) + (3 x 2) = 6 + 6 + 6 + 6 + 6 + 6 = 30

Students need opportunities to compose and decompose 3 dimensional rectangular prisms. They need experiences building prisms with unit cubes. When students are building they can apply their understanding of the associative property. (See below) Through these experiences they will learn to derive the formula for volume.

Base x Width x Height = Volume

B x W x H = V
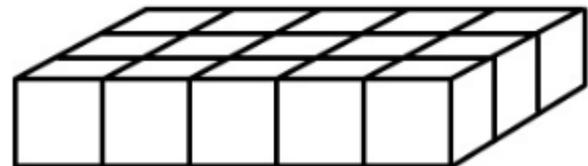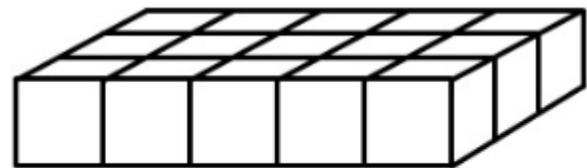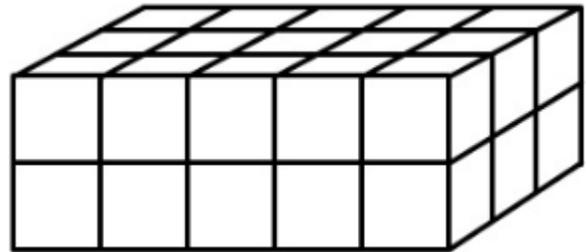
Commutative and Associative Property applied to Volume Measurement:

Task for Students: Have them build the following prisms. Have them descibe how they look. What is the total number of "cubic units" needed to build each one? Do they notice anything about the results?

2 x (5 x 3)

3 x (2 x 5)

3 x (5 x 2)

5 x (2 x 3)

5 x (3 x 2)

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Idea behind the task:

The purpose of this task is for students to use the volume of a rectangle prsm to see why you can multiply three numbers in any order you want and still get the same result. Formally, this is a consequence of the commutative and associative properties of multiplicaiton. For example, we can see that :

$$2 \times (3 \times 5) = 3 \times (5 \times 2)$$

By using the properties of multiplication step-by step:

$2 \times (3 \times 5) = (2 \times 3) \times 5$ (associative property)

$= (3 \times 2) \times 5$ (commutative property)

$= 3 \times (2 \times 5)$ (associative property

$= 3 \times (5 \times 2)$ (commutative property)

The big idea is that volume will be the same regardless of the order in which we name the dimensions.

Task for Students: Using 24 cubes build as many rectangular prisms as possible.   . Have them descibe how they look. What is the total number of "cubic units" needed to build each one? Do they notice anything about the results?

Create a chart to record your results.

Idea behind the task:

Length	Width	Height
1	2	12
2	2	6
4	2	3
8	3	1

The students will compose the rectangular arrays and connections should made through observations and discussions that they are finding all the factors of 24 when constructing the different prisms. Another connection to the associative property should also be made. (e.g. 2 x 2 x 6 = 4 x 2 x 6) See 5.NBT for more explaination of the properties of operations.

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Students need experience solving real world problems with the application of volume measurement.

Real World Problem Examples:

Task 1:

Below is a picture of a large block of taffy (candy) that is cut into "unit cubes" The store needs to cut apart this large cube into smaller sizes to sell. The store would like to sell these in bundles of 8 candies each. How many bundles can they get from the rectangular prism below?
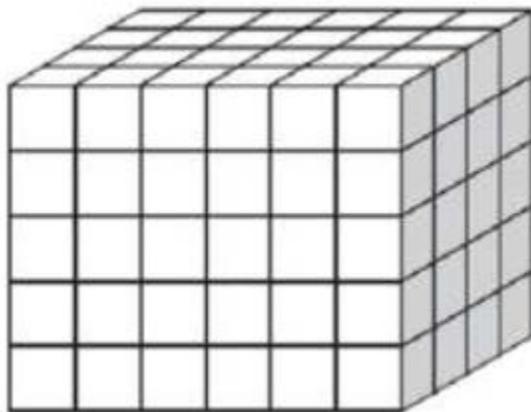
> When the student is solving this task, take notice if they are finding the volume with multiplication or repeated addition. Or do they need to build the structure with cubes to find the answer. Depending on their process to solve, this gives the teacher an idea of what types of experiences the student needs to experience. Are they ready to move on to a prisim that is not segmented with lines or do they need more experience building prisms with cubes to notice the patterns and derive the formula for volume.
> V = B x H x W

Task 2:

Work with a partner.
1. Create two different buildings using cm cubes. Each building must be made by joining two rectangular prisms made from cm cubes to make one solid figure.
2. Estimate the volume of each building. Which building do you predict will have the greatest volume? Record your estimates and prediction.
3. Find the volume of each rectangular prism and add to find the total volume of each building.
4. Use pictures, numbers and words to show what you discovered about your estimates, prediction and the volume of each building.