

Convert like measurement units within a given measurement system (Standard 5.MD.1).														
<b>Standard 5.MD.1</b> Convert among different-sized standard measurement units within a given measurement system ( <i>for example, convert 5 cm to 0.05 m</i> ); use these conversions in solving multi-step, real-world problems.														
Concepts and Skills to Master														
<ul style="list-style-type: none"> <li>• Convert within a given measurement system expressing smaller units in terms of larger units and larger units in terms of smaller units</li> <li>• Conceptualize conversions beyond memorized procedures and apply conversions to real-world and multi-step problems</li> </ul> <p>Teacher Note: This is an excellent opportunity to reinforce notions of place value for whole numbers and decimals, and connection between fractions and decimals rather than teaching mnemonic devices without understanding. Students should not be expected to memorize unit conversions; however, knowing relative sizes of measurement units within systems of units and having repeated exposure to commonly used units will support them in being able express measurements in terms of other units.</p>														
Related Standards: Current Grade Level		Related Standards: Future Grade Levels												
<p><b>5.NBT.2</b> Explain patterns in the number of zeros of the product when multiplying a number by powers of 10</p> <p><b>5.NBT.5</b> Fluently multiply multi-digit whole numbers using the standard algorithm</p> <p><b>5.NBT.6</b> Find whole-number quotients of whole numbers</p> <p><b>5.NBT.7</b> Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value</p>		<p><b>6.RP.3d</b> Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities</p>												
Critical Background Knowledge from Previous Grade Levels														
<ul style="list-style-type: none"> <li>• Know relative sizes of measurement units within each system of units. Express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table (4.MD.1)</li> <li>• Use the four operations to solve word problems involving distances, intervals of time, liquid volume, masses of objects, and money (4.MD.2)</li> <li>• Multiply or divide to solve word problems involving multiplicative comparisons (4.OA.2)</li> <li>• Solve multi-step word problem posed with whole numbers and having whole number answers using the four operations (4.OA.3)</li> </ul>														
Academic Vocabulary														
All units of measurement in customary and metric systems, including: kilometer, meter, centimeter, millimeter, liter, milliliter, kilogram, gram, milligram, mile, yard, foot, inch, gallon, quart, pint, cup, ton, pound, and ounce as well as abbreviations for symbols. (" = in., ' = ft.).														
Suggested Models		Suggested Strategies												
<p>In fifth grade the main focus is on arriving at the measurements that generate a table. In sixth grade, tables can be discussed in terms of ratios and proportional relationships</p> <table border="1" data-bbox="571 1112 865 1385"> <thead> <tr> <th>Feet</th> <th>Inches</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> </tr> <tr> <td></td> <td>1</td> </tr> <tr> <td></td> <td>2</td> </tr> <tr> <td></td> <td>3</td> </tr> <tr> <td></td> <td></td> </tr> </tbody> </table>		Feet	Inches	0	0		1		2		3			<ul style="list-style-type: none"> <li>• Explore how the base-ten system supports conversions within the metric system</li> <li>• Provide a variety of situations for students to measure within a given measurement system and convert those measurements within the same system</li> <li>• Measure the same object using two different units, then compare the measurements to the size of the units being used</li> <li>• Draw pictures and models to generalize conversions</li> <li>• Create a two-column chart or table to notice any patterns for converting within given measurements (see the table to the left)</li> </ul>
Feet	Inches													
0	0													
	1													
	2													
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Image Sources: <a href="https://commoncoretools.files.wordpress.com/2012/07/ccss_progression_gm_k5_2012_07_21.pdf">https://commoncoretools.files.wordpress.com/2012/07/ccss_progression_gm_k5_2012_07_21.pdf</a> , <a href="https://commoncoretools.files.wordpress.com/2012/02/ccss_progression_rp_67_2011_11_12_corrected.pdf">https://commoncoretools.files.wordpress.com/2012/02/ccss_progression_rp_67_2011_11_12_corrected.pdf</a>														

<p>Represent and interpret data (Standard 5.MD.2)</p> <p><b>Standard 5.MD.2</b> Make a line plot to display a data set of measurements in fractions of a unit (halves, quarters, eighths). Use operations on fractions for this grade to solve problems involving information presented in line plots. <i>For example, given graduated cylinders with different measures of liquid in each, find the amount of liquid each cylinder would contain if the total amount in all the cylinders were redistributed equally.</i></p> <p>Concepts and Skills to Master</p> <ul style="list-style-type: none"> <li>• Make a line plot using provided data sets; include a horizontal scale, title, labels, and straight columns of symbols to represent the data points (• or X)</li> <li>• Use a variety of strategies to solve addition and subtraction problems related to data on a line plot</li> </ul> <p>Teacher Note: In fifth grade students are not expected to generate measurement data, although they may. Measurement data to be plotted may represent length, volume, or mass. This standard is an extension of the fourth grade standard 4.MD.4.</p>	
<p>Related Standards: Current Grade Level</p> <p><b>5.NF.2</b> Solve real world problems involving the addition and subtraction of fractions referring to the same whole, including cases of unlike denominators</p> <p><b>5.MD.1</b> Convert among different-sized standards of measurement units within a given measurement system</p> <p><b>5.MD.5</b> Relate volumes to the operations of multiplication, addition and solve real-world and mathematical problems involving volume</p>	<p>Related Standards: Future Grade Levels</p> <p><b>6.SP.4</b> Display numerical data in plots on a number line, including dot plots, histograms, and box plots. Choose the most appropriate graph/plot for the data collected</p>
<p>Critical Background Knowledge from Previous Grade Levels</p> <ul style="list-style-type: none"> <li>• Make a line plot to display a data set of measurements in fractions of a unit (halves, quarters, and eighths). Solve problems involving addition and subtraction with like denominators of fractions by using information presented in line plots (4.MD.4)</li> <li>• Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot where the horizontal scale is marked off in appropriate units-whole numbers, halves, or quarters (3.MD.4)</li> </ul>	
<p>Academic Vocabulary</p> <p>line plot, scale, interval, data set</p>	
<p>Suggested Models</p> <div style="text-align: center;"> <p>Liquid in Beaker</p> <p>Amount of Liquid (in Liters)</p> </div>	<p>Suggested Strategies</p> <ul style="list-style-type: none"> <li>• Analyze and interpret data on created line plots</li> <li>• Measure objects to one-eighth of a unit, including length, mass, and liquid volume</li> <li>• Given a created line plot, write and solve questions related to the data</li> </ul>
<p>Image Source: <a href="http://www.dpi.state.nc.us/docs/curriculum/mathematics/scos/5.pdf">http://www.dpi.state.nc.us/docs/curriculum/mathematics/scos/5.pdf</a></p>	

Understand concepts of geometric measurement and volume, as well as how multiplication and addition relate to volume (Standard 5.MD.3-5)

**Standard 5.MD.3** Recognize volume as an attribute of solid figures and understand concepts of volume measurement.

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

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

Concepts and Skills to Master

- Understand that volume is an attribute of a solid or three dimensional figure
- Understand volume is measured in cubic units
- Explain why figures should be packed without gaps or overlaps
- Understand packing as a way to measure volume in cubic units

Related Standards: Current Grade Level

**5.MD.4** Measure volumes to the operations of multiplication and addition and solve real-world and mathematical problems in volume

**5.MD.5** Relate volume to the operations of multiplication and addition and solve real-world mathematical problems

Related Standards: Future Grade Levels

**6.G.2** Find the volume of a right rectangular prism with fractional edge lengths by packing it with unit cubes of the appropriate unit fraction edge lengths, and show that the volume is the same as would be found by multiplying the edge lengths of the prism. Apply the formulas  $V = l w h$  and  $V = b h$  to find volumes of right rectangular prisms with fractional edge lengths in the context of solving real-world and mathematical problems

**7.G.6** Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects

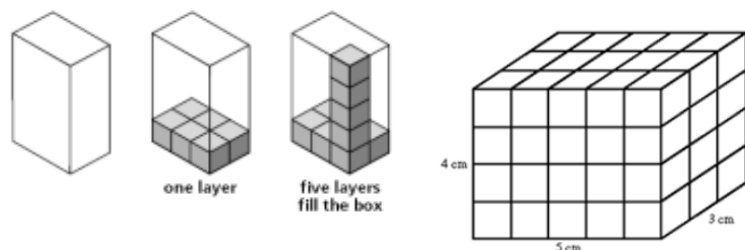
Critical Background Knowledge from Previous Grade Levels

- Recognize area as an attribute of plane figures and understand concepts of area measurement (3.MD.5)

Academic Vocabulary

Cube, Unit cube ( $n^3$ ), One cubic unit, Volume, Solid figure, Overlapping (a partial face to partial face creates a gap) vs. stacking (full face to full face), packing

Suggested Models



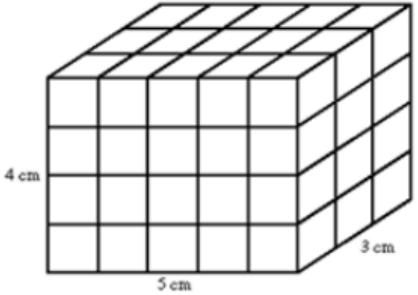
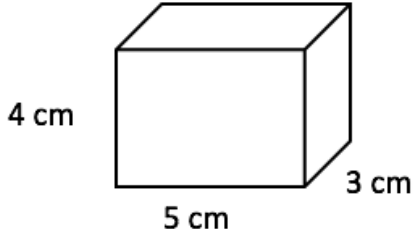
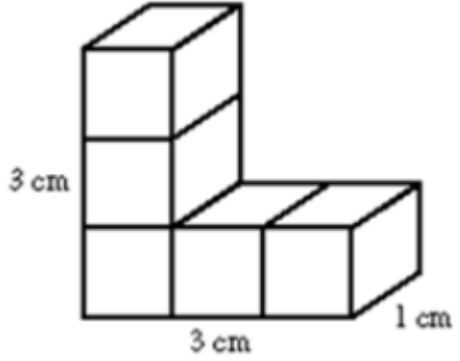
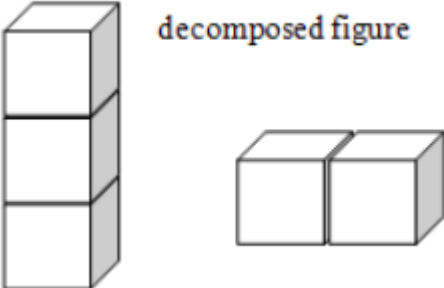
Suggested Strategies

- Fill a rectangular container with unit cubes and then with non-unit objects (marbles, packing peanuts, pom poms, etc.) to show how to represent volume
- Explore the concept of volume as an extension from area with the idea that students are covering an area (the bottom of the rectangular prism) with a layer of unit cubes and then adding layers of unit cubes on top of the bottom layer

Image Sources: <http://www.dpi.state.nc.us/docs/curriculum/mathematics/scos/5.pdf>;  
[https://commoncoretools.files.wordpress.com/2012/07/ccss\\_progression\\_gm\\_k5\\_2012\\_07\\_21.pdf](https://commoncoretools.files.wordpress.com/2012/07/ccss_progression_gm_k5_2012_07_21.pdf)

Understand concepts of geometric measurement and volume, as well as how multiplication and addition relate to volume (Standard 5.MD.3-5)	
<b>Standard 5.MD.4</b> Measure volumes by counting unit cubes, using cubic cm, cubic in., cubic ft., and improvised units.	
Concepts and Skills to Master	
<ul style="list-style-type: none"> <li>• Pack cubes into right rectangular prisms and count the cubes to determine the volume</li> <li>• Use the appropriate unit to measure volume while counting cubes</li> </ul>	
Related Standards: Current Course	Related Standards: Future Courses
<p><b>5.MD.3</b> Recognize volume as an attribute of solid figures and understand concepts of volume measurement</p> <p><b>5.MD.5</b> Relate volume to the operations of multiplication and addition and solve real-world mathematical problems</p>	<p><b>6.G.2</b> Find the volume of a right rectangular prism with appropriate fraction edge lengths by packing it with cubes of the appropriate unit fraction edge lengths and show that the volume is the same as would be found by volumes of right rectangular prisms with fractional edge lengths</p> <p><b>7.G.6</b> Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects</p>
Critical Background Knowledge	
<ul style="list-style-type: none"> <li>• Recognize volume as an attribute of solid figures and understand concepts of volume measurement (5.MD.3)</li> <li>• A solid figure can be packed using unit cubes is said to have a volume of <math>n</math> cubic units (5.MD.3b)</li> </ul>	
Academic Vocabulary	
Cubic in., Cubic ft., Cubic cm., Improvised units (non-standard cubic units)	
Suggested Models	Suggested Strategies
<p>The diagrams show: 1) An empty rectangular prism. 2) A rectangular prism with one layer of unit cubes at the bottom, labeled "one layer". 3) A rectangular prism with five layers of unit cubes, labeled "five layers fill the box". 4) A fully packed rectangular prism with dimensions 4 cm (height), 5 cm (width), and 3 cm (depth).</p>	<ul style="list-style-type: none"> <li>• Explore the concept of volume as an extension from area with the idea that students are covering an area (the bottom of the rectangular prism) with a layer of unit cubes and then adding layers of unit cubes on top of the bottom layer</li> <li>• Given a specified amount of cubes with several factors (24, 36, etc.), make as many rectangular prisms as possible with a volume of the specified cubic units recording possible dimensions</li> <li>• Build solid figures with unit cubes/linking cubes and determine the volume</li> </ul>
Image Source: <a href="http://www.dpi.state.nc.us/docs/curriculum/mathematics/scos/5.pdf">http://www.dpi.state.nc.us/docs/curriculum/mathematics/scos/5.pdf</a>	

Understand concepts of geometric measurement and volume, as well as how multiplication and addition relate to volume (Standard 5.MD.3-5)	
<p><b>Standard 5.MD.5</b> Relate volume to the operations of multiplication and addition and solve real-world and mathematical problems involving volume.</p> <p><b>a.</b> Find the volume of a right rectangular prism with whole-number side lengths by packing it with unit cubes, and show that the volume is the same as would be found by multiplying the edge lengths, equivalently by multiplying the height by the area of the base. Represent threefold whole-number products as volumes, <i>for example, to represent the associative property of multiplication.</i></p> <p><b>b.</b> Apply the formulas <math>V = l \times w \times h</math> and <math>V = b \times h</math> for rectangular prisms to find volumes of right rectangular prisms with whole-number edge lengths in the context of solving real-world and mathematical problems.</p> <p><b>c.</b> Recognize volume as additive. Find volumes of solid figures composed of two non-overlapping right rectangular prisms by adding the volumes of the non-overlapping parts, applying this technique to solve real-world problems.</p>	
Concepts and Skills to Master	
<ul style="list-style-type: none"> <li>Discover that multiplying the three edge lengths of a rectangular prism results in finding the volume</li> <li>Explain how to relate counting cubes to the formula for finding volume</li> <li>Understand and apply the formulas <math>V = l \times w \times h</math> and <math>V = b \times h</math></li> <li>Understand and solve real-world situations and problems by recognizing that volume is the number of cubic units needed to fill a solid figure</li> <li>Decompose a composite shape into rectangular prisms and Understand that volume is additive, the volumes of two or more solid figures added together is the volume of the composite figure</li> </ul>	
Related Standards: Current Grade Level	Related Standards: Future Grade Levels
<p><b>5.MD.3</b> Recognize volume as an attribute of solid figures and understand concepts of volume measurement</p> <p><b>5.MD.4</b> Measure volumes to the operations of multiplication and addition and solve real-world and mathematical problems in volume</p>	<p><b>6.G.2</b> Find the volume of a right rectangular prism with fractional edge lengths by packing it with unit cubes of the appropriate unit fraction edge lengths, and show that the volume is the same as would be found by multiplying the edge lengths of the prism. Apply the formulas <math>V = l \times w \times h</math> and <math>V = b \times h</math> to find volumes of right rectangular prisms with fractional edge lengths in the context of solving real-world and mathematical problems</p> <p><b>7.G.6</b> Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects</p>
Critical Background Knowledge from Previous Grade Levels	
<ul style="list-style-type: none"> <li>Apply the area and perimeter formulas for rectangles (4.MD.3)</li> <li>Measure and estimate liquid volumes (3.MD.2)</li> <li>Measure area by counting unit squares and relate area to the operations of multiplication and addition (3.MD.6, 3.MD.7)</li> <li>Compose three-dimensional shapes (1.G.2b)</li> </ul>	
Academic Vocabulary	
right rectangular prism, base, area of base ( $b$ ), length ( $l$ ), height ( $h$ ), width ( $w$ ), volume ( $V$ ), formula, additive	

Suggested Models	Suggested Strategies
    <p data-bbox="856 738 1113 771">decomposed figure</p>	<ul style="list-style-type: none"><li>• Pack a right rectangular prism with cubes and use equations to represent the model</li><li>• Solve problems involving more than one right rectangular prism by building with cubes and decomposing the shape</li><li>• Solve problems to find the dimensions when given the total volume</li><li>• Solve problems when given a pre-determined number of cubes to make as many right rectangular prisms possible with that volume</li><li>• Build prisms in layers, determine base layer and use multiplication to calculate volume</li></ul>
<p>Image Sources: <a href="http://www.dpi.state.nc.us/docs/curriculum/mathematics/scos/5.pdf">http://www.dpi.state.nc.us/docs/curriculum/mathematics/scos/5.pdf</a>, <a href="https://commoncoretools.files.wordpress.com/2012/07/ccss_progression_gm_k5_2012_07_21.pdf">https://commoncoretools.files.wordpress.com/2012/07/ccss_progression_gm_k5_2012_07_21.pdf</a></p>	