

## Grade 5 Math Unit 7-Geometry

### UNIT OVERVIEW

Grade 5 math instruction centers around 3 Critical Focus Areas. This unit addresses Critical Focus Area #3, **Developing understanding of volume**. (See Connections for explanation)

This unit includes work in the following clusters:

- classify two-dimensional figures into categories based on their properties
- geometric measurement: understand concepts of volume and relate volume to multiplication and to addition

### STANDARDS

#### CC\_Common Core State Standards - Mathematics (2010) - Grade 5

##### Domain 5.MD Measurement and Data

**Cluster Statement:** *Geometric measurement: understand concepts of volume and relate volume to multiplication and to addition.*

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

**5.MD.3.a** A cube with side length 1 unit, called a “unit cube,” is said to have “one cubic unit” of volume, and can be used to measure volume.

**5.MD.3.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.

**Standard 5.MD.4** Measure volumes by counting unit cubes, using cubic cm, cubic in, cubic ft, and improvised units.

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

**5.MD.5.a** 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, e.g., to represent the associative property of multiplication.

**5.MD.5.b** Apply the formulas  $V = l \times w \times h$  and  $V = b \times h$  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.

**5.MD.5.c** 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.

##### Domain 5.G Geometry

**Cluster Statement:** *Classify two-dimensional figures into categories based on their properties.*

**Standard 5.G.3** Understand that attributes belonging to a category of two-dimensional figures also belong to all subcategories of that category.

**Standard 5.G.4** Classify two-dimensional figures in a hierarchy based on properties.

### CONTENT ELABORATIONS

**5.G.3** calls for students to reason about the attributes of shapes. Students should have experiences discussing the property of shapes and explaining their reasoning. Geometric properties include *properties of sides* (parallel, perpendicular, congruent), *properties of angles* (type, measurement, congruent) and *properties of symmetry* (point and line).

*Example:* Examine whether all quadrilaterals have right angles. Give examples and non-examples.

**MP.2, MP.6, MP.7** should be emphasized.

5.G.4	<p><b>5.G.4</b> builds on what was done in grade 4. Figures from previous grades: polygon, rhombus/rhombi, rectangle, square, triangle, quadrilateral, pentagon, hexagon, cube, trapezoid, half//quarter circle, circle.</p> <p><b>MP.2, MP.3, MP.5, MP.6, MP.7</b> should be emphasized.</p>
5.MD.3	<p><b>5.MD.3-5</b> represents the first time that students begin exploring the concept of volume. Their prior experiences with volume were restricted to liquid volume. In grade 3, students begin working with area and covering spaces. The concept of volume should be extended from area with the idea that students are covering an area (the bottom of cube) with a layer of unit cubes and then adding layers of unit cubes on top of bottom layer. Students should have ample experiences with concrete manipulatives before moving to pictorial representations. As students develop their understanding of volume they recognize that a 1-unit by 1-unit by 1-unit cube is the standard unit for measuring volume. This cube has a length of 1 unit, a width of 1 unit and a height of 1 unit and is called a cubic unit. This cubic unit is written with an exponent of 3 (e.g., in<sup>3</sup>, m<sup>3</sup>). Students connect this notation to their understanding of powers of 10 in our place value system. Models of cubic inches, centimeters, cubic feet, etc. are helpful in developing an image of a cubic unit. Students estimate how many cubic yards would be needed to fill the classroom or how many cubic centimeters would be needed to fill a pencil box.</p> <p><b>MP.1-MP.8</b> should be emphasized.</p>
5.MD.4	<p>Students understand that same sized cubic units are used to measure volume. They select appropriate units to measure volume. For example, they make a distinction between which units are more appropriate for measuring the volume of a gym and volume of a box of books. They can also improvise a cubic unit using any unit as a length. Students can apply these ideas by filling containers with cubic units (wood cubes) to find volume. They may also use drawings and computer software to simulate the same filling process.</p>
5.MD.5a-b	<p><b>5.MD.5a-b</b> involve finding the volume of right rectangular prisms. Students should have experiences to describe and reason about why the formula is true. Specifically, that they are covering the bottom of a right rectangular prism (length x width) with multiple layers (height). Therefore, the formula (length x width x height) is an extension of the formula for the area of a rectangle.</p> <p><i>Examples:</i></p> <ul style="list-style-type: none"> <li>- When given 24 cubes, students make as many rectangular prisms as possible with a volume of 24 cubic units. Students build the prisms and record possible dimensions in a table.</li> <li>- A homeowner is building a swimming pool and needs to calculate the volume of water need to fill the pool. ( A design of a pool is shown in an illustration)</li> </ul>
5.MD.5c	<p><b>5.MD.5c</b> calls for students to extend their work with the area of composite figures into the context of volume. Students should be given concrete experiences of breaking apart 3-D figures into right rectangular prisms in order to find the volume of the entire 3-D figure. Students need multiple opportunities to measure volume by filling rectangular prisms with cubes and looking at the relationship between the total volume and the area of the base. They derive the volume formula and explore how this idea would apply to other prisms. Students use the associative property of multiplication and decomposition of numbers using factors to investigate rectangular prisms with a given number of cubic units.</p> <p><b>MP.1 - MP.8</b> should be emphasized.</p>

**UNIT VOCABULARY**

hexagon  
pentagon  
polygon  
octagon  
congruent angles  
congruent sides  
regular polygon  
attribute  
equilateral triangle  
isosceles triangle  
scalene triangle

acute triangle  
obtuse triangle  
right triangle  
trapezoid  
parallelogram  
rectangle  
rhombus  
square  
three-dimensional figure  
net  
cube

congruent figures  
rectangular prism  
face  
edge  
vertex  
prism  
base  
volume  
unit cube  
cubic unit  
composite figure

## BIG IDEAS

### ENDURING UNDERSTANDINGS

- Two-Dimensional figures are classified by their properties.
- Two-Dimensional figures can fit into more than one category.
- Volume can be expressed in both customary and metric units.
- Volume is represented in cubic units – cubic inches, cubic centimeters, cubic feet, etc.
- Volume refers to the space taken up by an object itself.
- Two-Dimensional figures are classified by their properties. • Two-Dimensional figures can fit into more than one category. Volume can be expressed in both customary and metric units. • Volume is represented in cubic units – cubic inches, cubic centimeters, cubic feet, etc. • Volume refers to the space taken up by an object itself.

### ESSENTIALS QUESTIONS

Choose a few questions based on the needs of your students

- How does geometry help me solve problems in everyday life?

## CONNECTIONS

In Critical Focus Area #3, 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 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 volume. They decompose three-dimensional shapes and find volumes of right rectangular prisms by viewing them as decomposed into layers of arrays of cubes. They measure necessary attributes of shapes in order to determine volumes to solve real world and mathematical problems.

The work in this unit is connected to **3.G.1, 4.NBT.5, 4.G.1-2**

**Standards for Mathematical Practice (SMP)**

**MP.1** Make sense of problems and persevere in solving them

**MP.2** Reason abstractly and quantitatively

**MP.3** Construct viable arguments and critique the reasoning of others

**MP.4** Model with mathematics

**MP.5** Use appropriate tools strategically

**MP.6** Attend to precision

**MP.7** Look for and make use of structure (Deductive reasoning)

**MP.8** Look for and express regularity in repeated reasoning (Inductive Reasoning)

**CLASSIFY TWO-DIMENSIONAL FIGURES INTO CATEGORIES BASED ON THEIR PROPERTIES**

	CONTENT	SKILLS
5.G.3	Understand that attributes belonging to a category of two-dimensional figures also belong to all subcategories of that category.	Understand that attributes belonging to a category of two-dimensional figures also belong to all subcategories of that category. 1. Recognize that some two-dimensional shapes can be classified into more than one category based on their attributes. 2. Recognize if a two-dimensional shape is classified into a category, that it belongs to all subcategories of that category.
5.G.4	Classify two-dimensional figures in a hierarchy based on properties.	Classify two-dimensional figures in a hierarchy based on properties. 1. Recognize the hierarchy of two-dimensional shapes based on their attributes. 2. Analyze properties of two-dimensional figures in order to place into a hierarchy. 3. Classify two-dimensional figures into categories and/or sub-categories based on their attributes.

**UNDERSTAND CONCEPTS OF VOLUME AND RELATION VOLUME TO MULTIPLICATION AND TO ADDITION**

	CONTENT	SKILLS
5.MD.3	Recognize volume as an attribute of solid figures and understand concepts of volume measurement.	Recognize volume as an attribute of solid figures and understand concepts of volume measurement. 1. Recognize that volume is the measurement of the space inside a solid three-dimensional figure. 2. Recognize a unit cube has 1 cubic unit of volume and is used to measure volume of three-dimensional shapes. 3. Recognize any solid figure packed without gaps or overlaps and filled with (n) "unit cubes" indicates the total cubic units or volume.

5.MD.4	Measure volume.	Measure volume. 1. Measure volume by counting unit cubes, cubic cm, cubic in., cubic ft., and improvised units.
5.MD.5a	Find the volume of a right rectangular prism.	Find the volume of a right rectangular prism. 1. Identify a right rectangular prism. 2. Find the volume of a right rectangular prism with whole number side lengths by packing it with unit cubes. 3. Develop volume formula for a rectangle prism by comparing volume when filled with cubes to volume by multiplying the height by the area of the base, or when multiplying the edge lengths (LxWxH) 4. Multiply the three dimensions in any order to calculate volume (Commutative and associative properties)
5.MD.5b	Apply the formulas $V=l \times w \times h$ and $V=B \times h$ for rectangular prisms to find volumes of right rectangular prisms with whole-number lengths in the context of solving real world and mathematical problems.	Apply the formulas $V=l \times w \times h$ and $V=B \times h$ for rectangular prisms to find volumes of right rectangular prisms with whole-number lengths in the context of solving real world and mathematical problems. 1. Know that “B” is the area of the base. 2. Apply the following formulas to right rectangular prisms having whole number edge lengths in the context of real world mathematical problems: Volume = length x width x height Volume = area of base x height
5.MD.5c	Recognize volume as additive.	Recognize volume as additive. 1. Solve real world problems by decomposing a solid figure into two non-overlapping right rectangular prisms and adding their volumes. 2. Recognize volume as additive.

A Link to Hierarchy - <http://www.mathsisfun.com/quadrilaterals.html>

Common Core Model Curriculum

McGraw-Hill, **My Math** Chapter 12

Georgia Math frameworks, Grade 5 Units 6-7

Smart Board resources

Math Playground/Common Core [http://www.mathplayground.com/common\\_core\\_state\\_standards\\_for\\_mathematics\\_grade\\_5.html](http://www.mathplayground.com/common_core_state_standards_for_mathematics_grade_5.html)

Educational games connecting with CCSS

IXL <http://www.ixl.com/math/standards/common-core/grade-5>

Rectangles and Parallelograms <http://illuminations.nctm.org/LessonDetail.aspx?ID=L350>

Polygon Capture <http://illuminations.nctm.org/LessonDetail.aspx?ID=L270> -

PLEASE NOTE--this game does NOT recognize a square as being a rectangle--use only if you can share with students that the game is actually wrong!