MA.5.GR.3.2

Overarching Standard: *MA.5.GR.3.2 Solve problems involving the volume of right rectangular prisms*

Benchmark of Focus
MA.5.GR.3.2 Find the volume of a right rectangular prism with whole-number side lengths using a visual model and a formula.

Benchmark Clarifications
Clarification 1: Instruction includes finding the volume of right rectangular prisms by packing the figure with unit cubes, using a visual model, or applying a multiplication formula.

Clarification 2: Right rectangular prisms cannot exceed two-digit edge lengths and responses include the appropriate units in word form.

Related Benchmark/Horizontal Alignment
- MA.5.NSO.2.1

Vertical Alignment

Previous Benchmarks	Next Benchmarks
MA.3.GR.2.2	MA.6.GR.2.3

Terms from the K-12 Glossary
- Rectangular Prism

Purpose and Instructional Strategies

The purpose of this benchmark is for students to make connections between packing a right rectangular prism with unit cubes to determine its volume and developing and applying a multiplication formula to calculate it more efficiently. Students have developed experience with area since Grade 3 (MA.3.GR.2.2). For volume, side lengths are limited to whole numbers in Grade 5, and problems extend to fraction and decimal side lengths in Grade 6 (MA.6.GR.2.3).
- Instruction should make connections between the exploration expected of MA.5.GR.3.1 and what is happening mathematically when calculating volume (MTR.2.1).
- Instruction should begin by connecting the measurement of a right rectangular prism to the calculation of a rectangle's area. The bottom layer of the prism is packed with a number of rows with a number of cubes in each, like area of a rectangle is calculated with unit squares. From there, the third dimension (height) of the prism is calculated by the number of layers stacked atop one another.
- Having students explore how volume is calculated helps students see the patterns and develop a multiplication formula that will help them make sense of the two most common volume formulas, $V = B \times h$ (where B represents the area of the rectangular prism's base) and $V = l \times w \times h$. If students understand conceptually what the formulas mean, they are more likely to use them effectively and efficiently (MTR.5.1).

• When students use a multiplication formula, it is important for them to see that it is a matter of choice which dimensions of rectangular prisms are named length, width and height. This will help students understand that when calculating the volume of a rectangular prism, the three dimensions are multiplied together and that the order of factors does not matter (commutative property of multiplication).

Common Misconceptions or Errors
• Students may confuse the difference between b in the area formula $A = b \times h$ and B in the volume formula $V = B \times h$. When building understanding of the volume formula for right rectangular prisms, teachers and students should include a visual model to justify their calculations.
• Students may make computational errors when calculating volume. Encourage them to estimate reasonable solutions before calculating and justify their solutions after. Instruction can also encourage students to find efficient ways to use the formula.
For example, when calculating the volume of a rectangular prism using the formula $V = 45 \times 12 \times 2$, students may find calculating easier if they multiply 45 x 2 (90) first, instead of 45 x 12. During class discussions, teachers should encourage students to share their strategies so they can build efficiency.

Questions to ask students:

- A toy box has a volume of 60 cubic feet. The box is 5 feet long and 4 feet wide. What is the height of the toy box?

Relate the measure of volume to using multiplication.
• Use a formula to find volume:

$$V = l \times w \times h \quad \text{or} \quad V = B \times h \ (B = l \times w)$$

3 in.

5 in.

7 in.
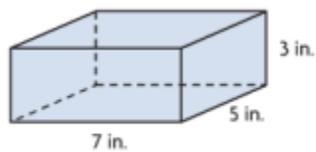
V = 7 in x 5 in x 3 in = 105 inches cubed   or   V = 35 in2 x 3 in = 105 in3 = 105 inches cubed

   o Sample answer that includes understanding: *Students can multiply 5 ft x 4 ft = 20 sq ft, and then use the total volume to find the missing factor (height). 20 x h = 60 cubic feet, so the height of the toy box is 20 feet.*

- Explain what it means to find the volume of a prism and how cubic units are used to measure volume.

Volume is the number of cubic units needed to fill the space inside a 3-dimensional figure.
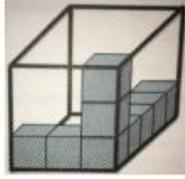
A rectangular prism is shown.

1 in. ☐
1 in.
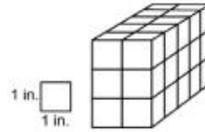
What is the volume of the prism in cubic inches?

- Sample answer that includes understanding: *Volume is 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.*


Instructional Tasks

Instructional Task 1
The Great Graham Cracker Company is looking for a new package design for next year's boxes. The boxes must be a right rectangular prism and measure 144 cubic centimeters. Part A. What are three package designs the company could use? Draw models and write equations to show their volumes. Part B. Dr. Cruz, the company's founder, wants the height of the package to be exactly 8 centimeters. What are two package designs that the company can use? Draw models and write equations to show their volumes.

Instructional Items
Instructional Item 1
Which of the following equations can be used to calculate the volume of the rectangular prism below?

15 in.

8 in.
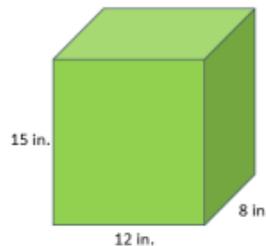
12 in.

a. $V = 96 \times 15$
b. $V = 15 \times 8 \times 12$
c. $V = 15 \times 20$
d. $V = 27 \times 8$
e. $V = 23 \times 12$

Instructional Item 2

A bedroom shaped like a rectangular prism is 15 feet wide, 32 feet long and measures 10 feet from the floor to the ceiling. What is the volume of the room?

a. 57 cubic ft.
b. 150 cubic ft.
c. 4,500 cubic ft.
d. 4,800 cubic ft.

Achievement Level Descriptors

Benchmark	Context	Assessment Limits
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ALD 2	ALD 3	ALD 4	ALD 5
When given a model, solves volume problems of a right rectangular prism with whole-number side lengths not greater than 3.	When given a model and a formula, finds the volume of a right rectangular prism with whole-number side lengths not greater than 5.	Finds the volume of a right rectangular prism with whole-number side lengths using a visual model and a formula.	Identifies figures with different dimensions that have the same volume.

Additional Resources:

CPALMS: https://www.cpalms.org/PreviewStandard/Preview/15410

LearnZillion: Understanding Volume http://bit.ly/2zuGljC

LearnZillion: Find Volume by Counting Cubes http://bit.ly/2SLjNUx

Working for Wonka - http://tinyurl.com/had8w32

Resources/Tasks to Support Your Child at Home:

Khan Academy: Find volume through decomposition Volume through decomposition (video) | Khan Academy

LearnZillion: Recognize Volume as Additive http://bit.ly/2Pdyguk