Topic B

Volume and the Operations of Multiplication and Addition

**5.MD.3, 5.MD.5**

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| Focus Standard: | 5.MD.3 | Recognize volume as an attribute of solid figures and understand concepts of volume measurement.   1. 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. 2. 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. |
| 5.MD.5 | Relate volume to the operations of multiplication and addition and solve real world and mathematical problems involving volume. |
|  | 1. 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. 2. Apply the formulas *V* = *l* × *w* × *h*  and *V* = *b* × *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. 3. 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. |
| Instructional Days: | 6 |  |
| Coherence -Links from: | G3–M4 | Multiplication and Area |
| -Links to: | G6–M5 | Area, Surface Area, and Volume Problems |

Concrete understanding of volume and multiplicative reasoning (**5.MD.3**)come together in Topic B as the systematic counting from Topic A leads naturally to formulas for finding the volumeof a right rectangular prism (**5.MD.5**). Students come to see that multiplying the edge lengths or multiplying the height by the area of the base yields an equivalent volume to that found by packing and counting unit cubes.

Next, students solidify the connection of volume as *packing* with volume as *filling* by comparing the amount of liquid that fills a container to the number of cubes that can be packed into it. This connection is formalized as students see that 1 cubic centimeter is equal to 1 milliliter. Complexity increases as students use their knowledge that volume is additive to partition and calculate the total volume of solid figures composed of non-overlapping rectangular prisms.

Word problems involving the volume of rectangular prisms with whole number edge lengths solidify understanding and give students the opportunity to reason about scaling in the context of volume. This topic concludes with a design project that allows students to apply the concepts and formulas they have learned throughout Topics A and B to create a sculpture of a specified volume composed of varied rectangular prisms with parameters stipulated in the project description.

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| A Teaching Sequence Toward Mastery of Volume and the Operations of Multiplication and Addition |
| Objective 1: Use multiplication to calculate volume. (Lesson 4) |
| Objective 2: Use multiplication to connect volume as *packing* with volume as *filling.* (Lesson 5) |
| Objective 3: Find the total volume of solid figures composed of two non-overlapping rectangular prisms. (Lesson 6) |
| **Objective 4: Solve word problems involving the volume of rectangular prisms with whole number edge lengths.** **(Lesson 7)** |
| **Objective 5: Apply concepts and formulas of volume to design a sculpture using rectangular prisms within given parameters.  (Lessons 8–9)** |