BURNETTE ELEMENTARY
Small Group Instructional Moves
5MA.D.8/8.C & 8.D

<table>
<tr><th colspan="2">Instructional Moves</th></tr>
<tr><td>AKS: 5MA.D.8 examine properties of polygons (e.g., triangles, quadrilaterals including kites, trapezoids, rectangles, squares, rhombuses, other parallelograms, pentagons, hexagons, octagons) and rectangular prisms; classify polygons by their properties; discover volume of right rectangular prisms.</td><td>Embedded QPTS Strategies:
Assessment & Feedback
Modeling and Practice</td></tr>
<tr><td colspan="2">IOA: 8.c investigate volume of right rectangular prisms by packing them with unit cubes without gaps or overlaps; determine the total volume to solve problems (5.GSR.8.3)
Misconception #1: Student struggles with determining the total volume of a rectangular prism.</td></tr>
<tr><td colspan="2">IOA: 8.d discover and explain how the volume of a right rectangular prism can be found by multiplying the area of the base times the height to solve authentic, mathematical problems (5.GSR.8.4)
Misconception #1: Student has difficulty describing what area is in order to use the Area of the Base x height and believe they are adding the dimensions
Misconception #2: Student has difficulty reasoning about how the area of the base relates to volume
Misconception #3: Student incorrectly calculates total volume due to computational errors.
Proficient #1: Student is proficient with determining total volume to solve problems.</td></tr>
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If:	Then:
IOA 8.c Misconception #1: Student struggles with determining the volume of a rectangular prism.	Since these AKS depend upon students' spatial abilities to conceptualize that each layer contains the same amount of units, time must be given for students to explore conceptually.

Teacher-led Small Group

Materials: snap cubes, Problems

Teach:

Present the following scenario to students:

Students will need snap cubes.

Mr. Sinyard bought a freezer. The freezer is rectangular and the space inside it measures 3 feet long by 4 feet wide by 3 feet high. What is the volume of the space inside the freezer?

"I'm picturing a freezer in my mind. It's shaped like a rectangular prism. I know that Mr. Sinyard is trying to find the volume of the space inside the freezer. We are going to use snap cubes to determine the volume of Mr. Sinyard's freezer."

"Let's begin by building the base layer. The freezer measures 3 feet long by 4 feet wide, so I will need to build a rectangular prism with my snap cubes that is 3 cubes long and 4 cubes wide."

Give students time to build the base layer.

"How many cubes were needed to build the base layer? How did you figure that out?"

<u>Sample Student Responses</u>

- "I needed 12 snap cubes. I know this because I counted all of them."
- "I needed 12 snap cubes. I know this because I multiplied 3 x 4 to get 12."

"We just found the volume of the base layer which is 12 snap cubes. We could determine the volume by counting all of the cubes we used. We could also determine the volume by counting the number of cubes in one layer and using repeated addition (based on the total number of layers).

"Let's keep going. Remember, we are trying to find the volume of the inside of the whole freezer. The freezer has a height of 3 feet. So far, our figure only has a height of 1."

"What do I still need to add to the figure?" (2 more layers which will make a height of 3).
"How can we figure out the volume?" (count all of the snap cubes or determine the number of cubes in one layer and use repeated addition (based on the total number of layers) to determine the total volume).

Give students time to build the remaining 2 layers and determine the volume.

Total volume: 12 + 12 + 12 = 36 cubic units

As students build a conceptual understanding of volume, they will begin to discover more efficient strategies for determining the total volume of a rectangular prism.

Additional Practice

- Mrs. Fisher is packing a box full of books. She is trying to determine the volume of the box, so she will know how many books she can pack inside it. The box is 3 feet long by 2 feet wide by 4 feet high. What is the volume of the box?

If:	Then:
IOA 8.d Misconception #1: Student has difficulty describing what area is in order to use the Area of the Base x height and believe they are adding the dimensions	This group will need to go back to the use of concrete manipulatives and focus on areas as a process of covering a two-dimensional space, and then relate that to volume. Physically build boxes with multiple dimensions using linking cubes. Allow students to do the same with actual manipulatives or virtual manipulatives.

Teacher-led Small Group

Materials: snap cubes, grid paper

Teach:

The teacher will first ask students what they know about area. Students might think area is adding all of the sides together to find the outside of the object (perimeter). Students might also respond that area is the amount of space in the inside of a 2-D figure.

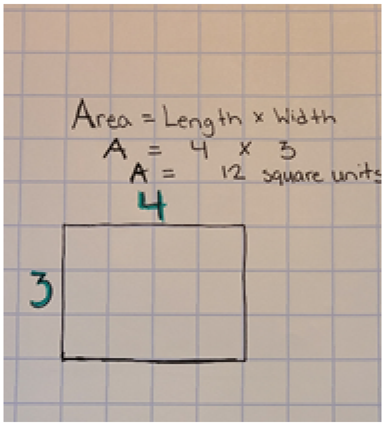
Foster this thinking and start with an understanding of the area by creating a rectangle with the dimension of 4x3 on grid paper.

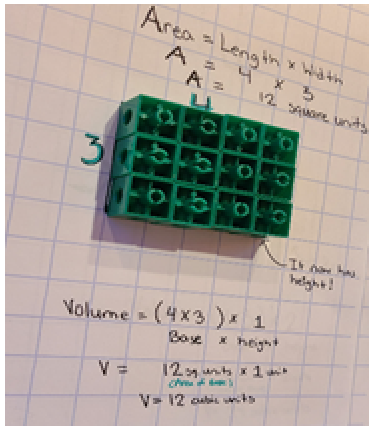
"I know that when I am finding area, I am really finding how many square units fill the 2-D space. In this figure, I have 4 as my length and 3 as my width. I can multiply 4 x 3 to determine that 12 square units cover the inside of this figure."

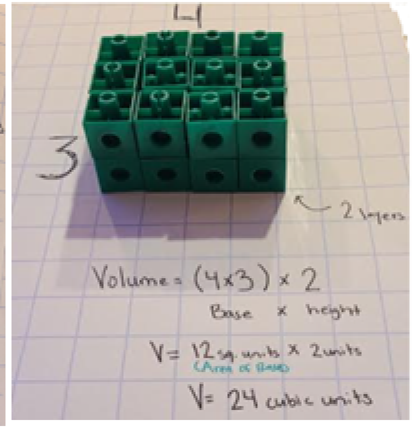
"What if I stack this figure with linking cubes? Now it becomes 3 dimensional. That means it is a solid shape that is made of cubic units and has a volume. How many cubes or cubic units have created this figure? Well, I have the area of the base as 12 square units. I see that this figure is just one unit in height, so my volume is still 12. It's 12 cubic units because now it's 12 cubes that fill this figure. So, I can say (4 x 3) is the area of my base (or the bottom of the figure)and then I can multiply it by it's height of 1 unit. 4 x 3 x 1 is 12 cubic units."

"Let's add another layer. When I do that, my height changed to 2 units. To find the volume now, I can still use what I know about the base. The area of the base is still 12 square units, but now the height is 2 units. Now I can determine the volume and say (4x3) x 2. That now gives me a volume of 24 cubic units because there are 24 cubes that make this 3-d figure."

"What if I added another layer? How would that change the volume? What could I do to find the volume?"







Allow students to respond.
Possible student responses: I could add another layer of 12 or I could say (4x3) x 3 now.

"So, when finding volume, I can find the area of the base first. Then, I can multiply that by how many layers there are. Let's try more."

The teacher will allow students to practice building the following shapes using linking cubes or virtual manipulatives.

Allow students to try:
Base: (5x2)...vary the height as we did in the teach portion of the lesson.

The teacher can then create rectangular prisms using the manipulatives and allow students to determine the area by applying the formula Bxh.

If:	Then:
IOA 8.d Misconception #2: Student has difficulty reasoning about how the area of the base relates to volume	This group should continue to practice using representational models to apply the formula.

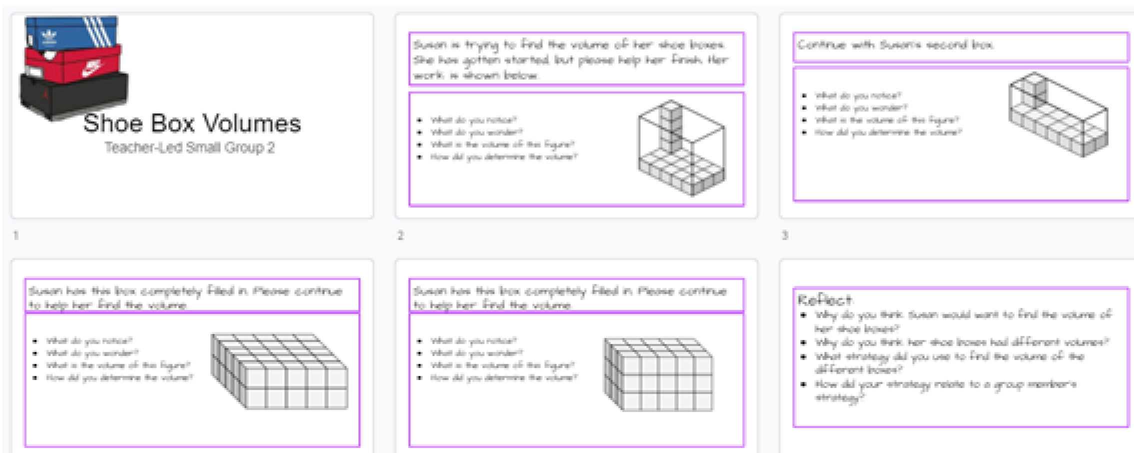
Teacher-led Small Group

Materials: Shoebox Task

Teach:

Teachers can use a task like the "Shoebox Task" to encourage students to use the formula with representational models.

- The teacher can begin by modeling the first problem using snap cubes, then making the connection to the representational models.
- Then, allow students to continue to practice.



If:	Then:
IOA 8.d Misconception #3: Student incorrectly calculates total volume due to computational errors.	Consider explicitly teaching thinking strategies to support students with developing basic fact fluency.

Teacher-led Small Group

Materials: Thinking Strategies for Multiplication Facts

Teach:

"Basic facts truly are *the* foundation on which all mathematical computation is based. By exploring the meaning of numbers and operations, describing their thinking, making sense of strategies, and engaging in meaningful practice, students eventually reach mastery of the basic facts." (Math Fact Fluency by Jennifer Bay-Williams and Gina Kling (2019), pg. vii)

"Developing fluency with basic facts is a developmental process. There are four elements of fluency: flexibility, appropriate strategy use/choice, efficiency, and accuracy. Students progress through three phrases to reach mastery of basic facts:

1. *Counting strategies:* using object counting or verbal counting to determine the answer
2. *Reasoning strategies:* using known information to logically determine an unknown combination
3. *Mastery:* producing answers efficiently

Explicitly teaching thinking strategies is effective in helping all students learn their basic facts. Students are explicitly taught a strategy, then explore and practice the strategy.
This explicit teaching of strategies supports students' reasoning in choosing which strategies best help them determine solutions rather than memorizing facts. A heavy focus on memorizing basic facts results in students who lack number-sense." (Teaching Student-Centered Mathematics by Van de Walle et al, (2018)

The thinking strategies for multiplication are based on foundational fact sets and derived fact strategies. This means that foundational fact sets can be used to derive other facts. The Multiplication Thinking Strategies table includes these sets of facts along with thinking strategies for them.

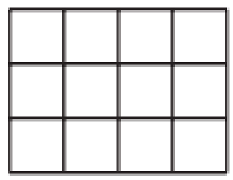
Teacher note: Use formative data to determine the strategy that will best support students in the process of building fact fluency. See full list of strategies in the "Thinking Strategies for Multiplication Facts" document found in the materials section.

If:	Then:
IOA 8.d Proficient #1: Student is proficient with determining total volume to solve problems.	Provide opportunities to extend students' understanding of volume to solve authentic, mathematical problems. Students can describe the impact of increasing or decreasing a side length in volume calculations (e.g.; if the height of a prism is increased by 2 units, what impact does that have on the volume of the rectangular prism?) **(Extension)** (5.GSR.8.5.e)

Teacher-led Small Group

Materials: Unit cubes (snap cubes, centimeter cubes); Teacher Guiding Questions

Teach:
This is the base of a rectangular prism with a height of 5 cubic units.



Student Problems:

- If the width is increased by 3 units, what impact does that have on the total volume of the rectangular prism?
- If the length is cut in half, what impact does that have on the total volume of the rectangular prism?
- If the height is doubled, what impact does that have on the total of the rectangular prism?

Teacher Guidance:

- Students in this group are proficient, so consider using questioning stems to facilitate discourse rather than explicitly modeling how to solve one of the problems.
- Provide access to unit cubes (snap cubes, centimeter cubes), so students can build models to support their reasoning.
- The focus here is on reasoning how increasing or decreasing a dimension will impact volume calculations (not just specifically determining the total volume).

Teacher Guiding Questions:

- What is the relationship between ____ and ____?
- How does knowing ____ help you ____?
- How does ____ compare to ____?
- How does increasing a dimension affect the total volume of a rectangular prism?
- How does decreasing a dimension affect the total volume of a rectangular prism?