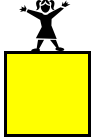
SCAFFOLDING TASK: Differentiating Area and Volume



STANDARDS FOR MATHEMATICAL CONTENT

MCC5.MD.3 Recognize volume as an attribute of solid figures and understand concepts of volume measurement.

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.

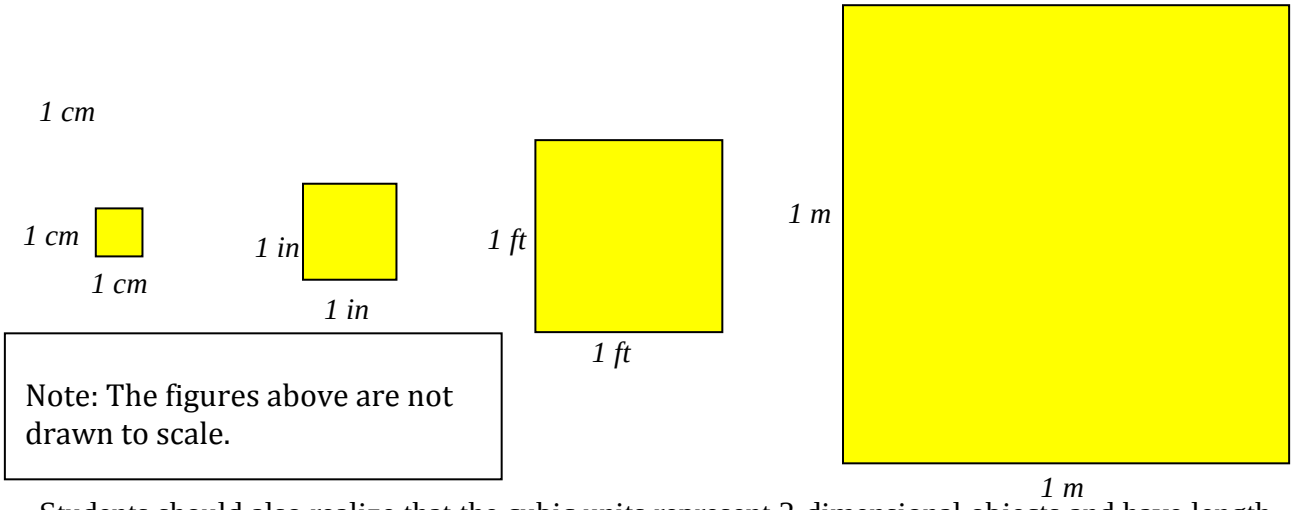
b. A solid figure which can be packed without gaps or overlaps using *n* unit cubes is said to have a volume of *n* cubic units.

STANDARDS FOR MATHEMATICAL PRACTICE

1. **Make sense of problems and persevere in solving them.**
2. **Reason abstractly and quantitatively.**
3. **Construct viable arguments and critique the reasoning of others.**
4. **Model with mathematics.**
5. **Use appropriate tools strategically.**
6. **Attend to precision.**
7. **Look for and make use of structure.**
8. **Look for and express regularity in repeated reasoning.**

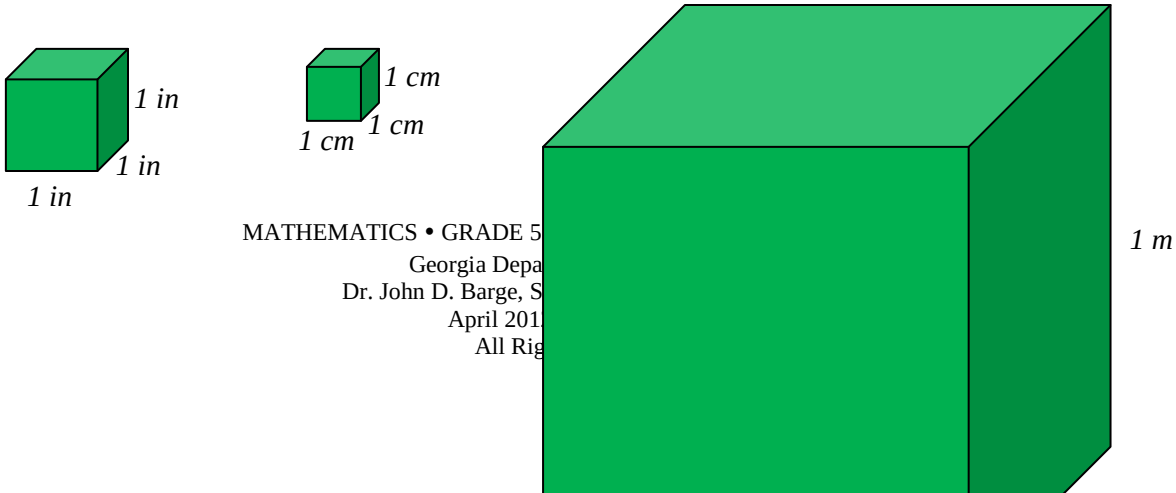
BACKGROUND KNOWLEDGE

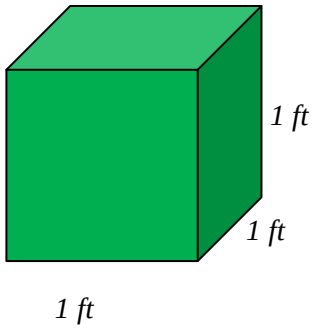
Students should realize that the square units represent 2-dimensional objects and have both length and width. If students are having difficulty determining how to create these, have a class discussion about the word "square." What comes to mind? How do you think this word might be related to area?



Note: The figures above are not drawn to scale.

Students should also realize that the cubic units represent 3-dimensional objects and have length, width, and height. If students are having difficulty determining how to create these, have a class discussion about the words "cube" and "cubic." What comes to mind? How do you think these words might be related to volume?





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Common Misconceptions:
Some students may think the term "square" refers only to the geometric figure with equal length sides. They will need to understand that area of any rectangle is measured in square units. The same idea may be present in "cubic units". Students may think it only has to do with the geometric solid "cube". They need to understand that "cubic units" are used to measure any rectangular prism.

ESSENTIAL QUESTIONS

- Why is volume represented with cubic units and area represented with square units?
- How are area and volume alike and different?

MATERIALS

- "Differentiating Area and Volume" student recording sheet
- newspaper
- construction paper
- copy paper
- grid paper (cm, in)
- scissors
- masking tape
- rulers
- meter sticks
- measuring tape
- cardstock or poster board
- markers

GROUPING

Small Group

TASK DESCRIPTION, DEVELOPMENT, AND DISCUSSION

Students create a display of square and cubic units in order to compare/contrast the measures of area and volume.

Comments

This is a cooperative learning activity in problem solving. Students are provided with materials, but no initial instruction is given on how to build the models. This task will help give students a tangible model of square units and cubic units.

To open this task, students can discuss in their small groups what they know about area and volume. Key points of a class discussion can be recorded on chart paper.

Students will work in small groups to build models to represent units of area and units of volume. When the groups have completed their projects they will share with the class what they built, what each is called, and how each compares to some of the other models built by other groups.

Task Directions

Students will follow the directions below from the "Differentiating Area and Volume" student recording sheet.

> Create a display for area and volume by creating the following models. Use newspaper, construction paper, copy paper, grid paper, scissors, masking tape, meter sticks, markers and/or cardboard to build the models.
>
> - Area models – 1 cm^2, 4 cm^2, 1 in^2, 4 in^2, 1 ft^2, 1 m^2
> - Volume models – 1 cm^3, 8 cm^3, 1 in^3, 8 in^3, 1 ft^3, 1 m^3
>
> At the end of the work period, each group will share their completed models and explain what has been built, what each is called, and how your models compare with some of the other models built by the other groups.
>
> Individually, answer the following questions:
>
> - How are area and volume alike?
> - How are area and volume different?
> - Why is area labeled with square units?
> - Why is volume labeled with cubic units?
> - Think about your home – bedroom, kitchen, bathroom, living room.
>   - What would you measure in square units? Why?
>   - What would you measure in cubic units? Why?

FORMATIVE ASSESSMENT QUESTIONS

- What does cm^2 mean? cm^3? How do you know?
- What does in^2 mean? in^3? How do you know?
- What does ft^2 mean? ft^3? How do you know?
- What does m^2 mean? m^3? How do you know?
- What shape is used to represent cm^2? cm^3? in^2? in^3? ft^2? ft^3? m^2? m^3?
- How can you create a shape that represents 4 cm^2? What length would you use? How do you know?
- How can you create a shape that represents 8 cm^3? What length would you use? How do you know?

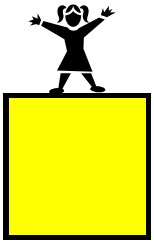
DIFFERENTIATION

Extension

- Ask students to describe the relationship between 4 cm^2 and 8 cm^3 as well as 9 cm^2 and 27 cm^3. Then have students generate other pairs of numbers that have the same relationship. What do they notice? (Students may use 1 cm cubes placed on a 4 cm^2 or 9 cm^2 square to determine the dimensions of a cube built on the square.)

Intervention

- Allow students to create at least some of the figures using a word processing or a drawing computer program. This will allow students to easily create right angles, equal side lengths, and cubes with equal edge lengths.
- Students may benefit from using 1" square tiles, 1" cubes, and similar 1 cm materials to create some of these models, especially 4 cm^2, 4 in^2, 8 cm^3, and 8 in^3.



Name_____Date _____

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At the end of the work period, each group will share their completed models and explain what has been built, what each is called, and how your models compare with some of the other models built by the other groups.

Individually, answer the following questions:

1. How are area and volume alike?

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2. How are area and volume different?

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3. Why is area labeled with square units?

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4. Why is volume labeled with cubic units?

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5. Think about your home – bedroom, kitchen, bathroom, living room.

   What would you measure in square units? Why?

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   What would you measure in cubic units? Why?

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