Gateway Regional School District

Atlas

Unit Plan

5.1 Finding Volume

Chester / Littleville Elementary / Grade 5 / Mathematics

Week 1 - Week 3 | 4 Curriculum Developers | Last Updated: Mar 20, 2024 by LeBlanc, Deanna

Style Guide

What is the purpose of the unit? What are the major take-aways?

Standards

MA: Mathematics (2017)
MA: Grade 5
Operations & Algebraic Thinking

5.OA Write and interpret numerical expressions.

- [x] 1. Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols, e.g., (6 x 30) + (6 x 1/2).
- [x] 2. Write simple expressions that record calculations with numbers, and interpret numerical expressions without evaluating them.
  Show Details

Measurement & Data

5.MD Geometric measurement: understand concepts of volume and relate volume to multiplication and to addition.

- [x] 3. Recognize volume as an attribute of solid figures and understand concepts of volume measurement.
- [x] 5. Relate volume to the operations of multiplication and addition and solve real world and mathematical problems involving volume.
- [x] 4. Measure volumes by counting unit cubes, using cubic cm, cubic in, cubic ft, and non-standard units.

Enduring Understandings

Enduring Understandings for "5.1 Finding Volume":

1. Mathematical Operations Structure:
Students will understand that mathematical expressions, including those representing volume, can be structured in various ways using parentheses, brackets, and braces to indicate the order in which operations are to be performed. This understanding will help them evaluate expressions systematically and understand the hierarchy of operations within a given expression, such as when calculating volumes of composed figures.

2. Symbolic Representation:
Students will comprehend that equations and expressions are wayfinding tools that can symbolize and communicate mathematical thinking. They will recognize that simple expressions can represent the calculations required to determine volume, which allows them to communicate solutions and understandings without necessarily performing the calculations.

Essential Questions

1. How can we apply our understanding of the order of operations, including the use of parentheses, brackets, or braces, to calculate quantities like volume?

2. In what ways can writing simple expressions help us record and understand calculations related to volume without actually computing the values?

3. Why is volume an important attribute of solid figures and how does our perception of a 3D object change when we understand its volume?

4. How are the concepts of multiplication and addition related to measuring and calculating the volume of an object?

5. What strategies can we use to accurately measure the volume of irregularly-shaped objects using unit cubes and other units like cubic centimeters, inches, or feet?

3. Volume as a Spatial Attribute:
Learners will realize volume is a fundamental attribute of three-dimensional space within solid figures, as it quantifies the capacity or space that a solid occupies. They will appreciate that volume is measured in cubic units, which connects to real-life contexts.

4. Connection between Arithmetic and Geometry:
Students will recognize that volume can be determined through multiplication and addition operations, translating the three-dimensional problem of finding volume into a series of one- or two-dimensional arithmetic calculations. They will also understand that these operations can be used to solve practical problems involving space and capacity in the world around them.

5. Volume Measurement Strategies:
Students will understand that volume can be measured by counting the number of unit cubes that fit within a solid figure. They will realize the importance of standard units of measure, such as cubic centimeters, cubic inches, and cubic feet, and see how these units facilitate communication and comparison of volumes. In addition, they will explore how non-standard units can also be used to measure volume when standard units are not available, recognizing the flexibility and creativity involved in measurement.

6. How can understanding volume help us solve real-life problems, and why is it important to be able to determine the volume of both standard and non-standard shapes?

7. What similarities and differences do you notice when measuring volume versus measuring other attributes like length or area?

8. Why do we use cubic units to measure volume, and how does this unit help us understand the space occupied by a three-dimensional object?

Content

This unit introduces students to the concept of volume by building on their understanding of area and multiplication.
In grade 3, students learned that the area of a two-dimensional figure is the number of square units that cover it without gaps or overlaps. They first found areas by counting squares and began to intuit that area is additive. Later, they recognized the area of a rectangle as a product of its side lengths and found the area of more-complex figures composed of rectangles.
Here, students learn that the volume of a solid figure is the number of unit cubes that fill it without gaps or overlaps. First, they measure volume by counting unit cubes and observe its additive nature. They also learn that different solid figures can have the same volume.

Next, they shift their focus to right rectangular prisms: building them using unit cubes, analyzing their structure, and finding their volume. They write numerical expressions to represent their reasoning strategies and work with increasingly abstract representations of prisms.

Later, students generalize that the volume of a rectangular prism can be found by multiplying its side measurements (length×width×heightlength×width×height), or by multiplying the area of the base and its height (area of the base×heightarea of the base×height). As they analyze, write, and evaluate different expressions that represent the volume of the same prism, students revisit familiar properties of operations from earlier grades.
Later in the unit, students apply these understandings to find the volume of solid figures composed of two non-overlapping rectangular prisms and solve real-world problems involving such

Skills

Section A Goals
- Describe volume as the space taken up by a solid object.
- Measure the volume of a rectangular prism by finding the number of unit cubes needed to fill it.
- Use the layered structure in a rectangular prism to find volume.

Section B Goals
- Describe the calculations from the previous section as length×width×heightlength×width×height or area of the base×heightarea of the base×height.
- Find volume using length×width×heightlength×width×height or area of the base×heightarea of the base×height.

Section C Goals
- Find the volume of a figure composed of rectangular prisms.

figures. In doing so, they also progress from using cubes to using standard units to measure volume.

Throughout the unit
Students build on the multiplication and place value concepts from grades 3 and 4 to work toward fluency in multi-digit multiplication in grade 5. Because this unit focuses on the multiplication of three factors to find the volume, each Number Talk in this unit allows students to practice multiplying mentally with three factors. The product builds from simple factors such as 3×2×4 to factors that include multiples of 10, such as 60×20×10.
This progression intentionally incorporates multiples of 10 so that teachers can see how students apply place value understanding and the associative and distributive properties of operations to multiply. Teachers can use these warm-ups to build towards the grade 5 work with place value and multiplication.

How will you gauge student learning?

Assessments

5.1 End-of-Unit Assessment | Summative | Written Test

Grade5-1-End-of-Unit-Assessment-assessment.pdf

8 State Standards Assessed

How will students learn?

Learning Activities

Section A:
In this section, students make sense of volume as a measurement of three-dimensional figures by building objects with unit cubes and counting the cubes. They experiment with different figures made from the same number of cubes and see them as having the same volume. Students then build right rectangular prisms and analyze images of prisms constructed of unit cubes. To find the volume of these solids, students look at their structure and relate the number of horizontal and vertical layers to the total number of cubes (MP7). They engage with the commutative and associative properties of multiplication as they reason about the volume of rectangular prisms that are oriented in different ways.

Section B:
In this section, students continue to work with right rectangular prisms and to relate side measurements to volume. They observe that multiplying the number of layers of cubes in a prism by the number of cubes in one layer gives its volume. They also see that the number of cubes in one layer is in essence the area of a rectangle.
Students then generalize the volume of a right rectangular prism as the product of its side lengths, length×width×height and as the product of the area of its base and its height, base area×heightbase area×height.
To promote flexible use of measurements and sense making in finding volume, students connect these mathematical terms to numerical expressions that represent volume, rather than relying on algebraic formulas. This work reinforces the associative property of multiplication and highlights that the volume of a rectangular prism can be represented with equivalent multiplication expressions.

Section C:
In this section, students apply their understanding of volume to solve real-world and mathematical problems. They encounter solid figures that are composed of two or more right rectangular prisms, which reinforces their understanding of the additive nature of volume.
Students also work with side lengths that are larger than those in earlier sections, prompting them to activate multiplication strategies from earlier grades. The work reminds students that they can decompose multi-digit factors by place value to find their product, paving the way toward the standard algorithm for multiplication in a later unit.

Differentiated Instruction

Technology Integration

21st Century Skills

Positive Behavior

CASEL

Collaborative for Academic, Social, and Emotional Learning

Resources

Teacher Notes and Reflections