The Sandbox: Perimeter, Area, and Volume

Strand: Measurement and Geometry

Topic: Differentiating among area, perimeter, and volume and solving practical problems.

Primary SOL: 5.8 The student will
a) solve practical problems that involve perimeter, area, and volume in standard units of measure; and
b) differentiate among perimeter, area, and volume and identify whether the application of the concept of perimeter, area, or volume is appropriate for a given situation.

Related SOL: 5.12

Materials

- Sort It Out activity (attached)
- The Sandbox activity (attached)
- Grid paper (attached)
- Paper Square measuring 2' x 2'
- Straight edge
- Scissors

Vocabulary

area, base, cube, cubic unit, dimensions, height, length, perimeter, rectangle, rectangular prism, rectangular right triangle, solid, square, square unit, volume, width

Student/Teacher Actions: What should students be doing? What should teachers be doing?

1. Distribute The Sandbox activity sheet to the students. Tell the students the community is adding a sandbox to the local park and they need some help deciding how much material to purchase to build the sandbox. Inform them that a representation of the components to design the sandbox are shown, and the parents want the sandbox to be 1 foot high.
    a. Ask students to use the information on the activity sheet to estimate how many wooden boards and sheets of plastic covering are needed for the sandbox. Circulate and facilitate as needed. (Close estimates are five pieces of wood for the length and four pieces of wood for the width). Record their estimates on the board and discuss why some estimates might be different.
    b. Write the terms *area* and *perimeter* on the board, and ask whether anyone knows how these terms are related to the sandbox. Ask, *"What measure will be needed to figure out how much sand it will take to fill the sandbox?"* Allow students to discuss.
2. Ask students to find the actual measurements for the perimeter, area, and volume of the sandbox using the following information:

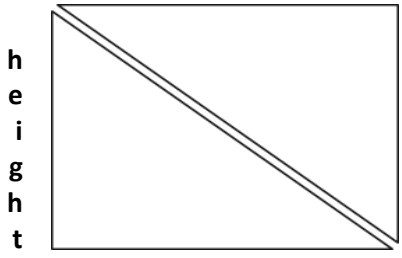
Wood Plank	Length: 2 feet
Piece of Plastic	The two equal sides/legs are 2 feet each
Height of Sandbox	1 foot

You may want students work with like ability partners. Write the following information on the board.

Give students time to work on finding the measures, and circulate around the room to note which students may have gaps in the knowledge they need to solve the problem. Facilitate a class discussion that revisits the important ideas about perimeter, area, and volume that differentiate the measures from each other. Review the use of formulas to find the measures. Emphasize the need to include units with the answers.

3. Next, tell the students the parents would like to put triangular seats at each corner of the sandbox. During the discussion of this part of the lesson, review the characteristics of a right triangle. Each seat has three sides, and the two legs measure 2 feet each (we do not know the length of the third side, called the hypotenuse of the right triangle, which is opposite the right angle).
    a. Give students a square paper measuring 2' x 2'. Ask students to find the area of the square. Draw a representation of the square on the board, and ask students to determine the area. Label the length as 2 feet and width as 2 feet. Direct students to draw a diagonal line using a straight edge from one vertex to the opposite vertex and to cut along the diagonal created. This will result in two right triangles to make the seats. Ask students to talk with their elbow partner to determine the area of one of the right triangles.
    b. Then ask for volunteers to provide the area of a right triangle and how they determined their answer. Sample response: "The area of the rectangle was 4 square feet. When the rectangle is cut in half, the area is also cut in half. Half of 4 square feet is 2 square feet. So the area of the right triangle is 2 square feet." Record this idea in words that can be used to develop the formula.
    c. Facilitate a discussion to create an anchor chart that includes key terms applied to right triangles. In order to move students from the description to the formula, you will need to make the connections between the dimensions of a rectangle to the dimensions of a right triangle.

Area of Rectangle = length x width



Area of Right Triangle = $\frac{1}{2}$ x base x height

4. Working with a partner, students should create an information sheet to find the measurements for a shape with any dimensions. Review that letters are used when there is no specific measurement (i.e., *l* for length, *w* for width, *h* for height, and *b* for base). Present the chart below on the board as a way for students to organize their notes, and tell them to start with a clean sheet of paper turned horizontally.

Shape and the Measure Needed	Sketch of the shape with the dimensions labeled	Describe how to find the measure needed.	Record a formula for finding the measure.	How is the answer presented? (sq. ft., cu. ft.)
Perimeter of a rectangle				
Area of a rectangle				
Volume of a rectangular solid/prism				
Area of a right triangle				

- Circulate around the room as students work and note who is confused or has misconceptions. Pose questions to help students get started or if they get stuck.
- When students are finished, have pairs of partners get together to compare their notes and make any revisions they want to make.

Assessment

- **Questions**
  - Distribute the Sort It Out activity sheet to the students. Ask the students to sort each situation under the labels Perimeter, Area, and Volume.
  - What is the difference between perimeter, area, and volume?
  - Compare measuring the area of a rectangle and an area of a right triangle.
- **Journal/writing prompts**
  - Describe a situation in which you would need to find the area.
  - Describe a situation in which you would need to find the perimeter.
  - Describe a situation in which you would need to find the volume.
  - Describe a situation in which you would need to find the area of a triangle.
- **Other Assessments**
  - The community is adding another sandbox to the city park. To make the edge of the sandbox, they have 20 planks of wood that are each 2 feet long. On a piece of grid paper, show all the ways that you can arrange the pieces of wood into a rectangle. Which of the rectangles has the largest area? If the height of the sandbox is 2 feet, how much sand would they need for each sandbox you drew? Which sandbox has the least volume of sand?

Extensions and Connections

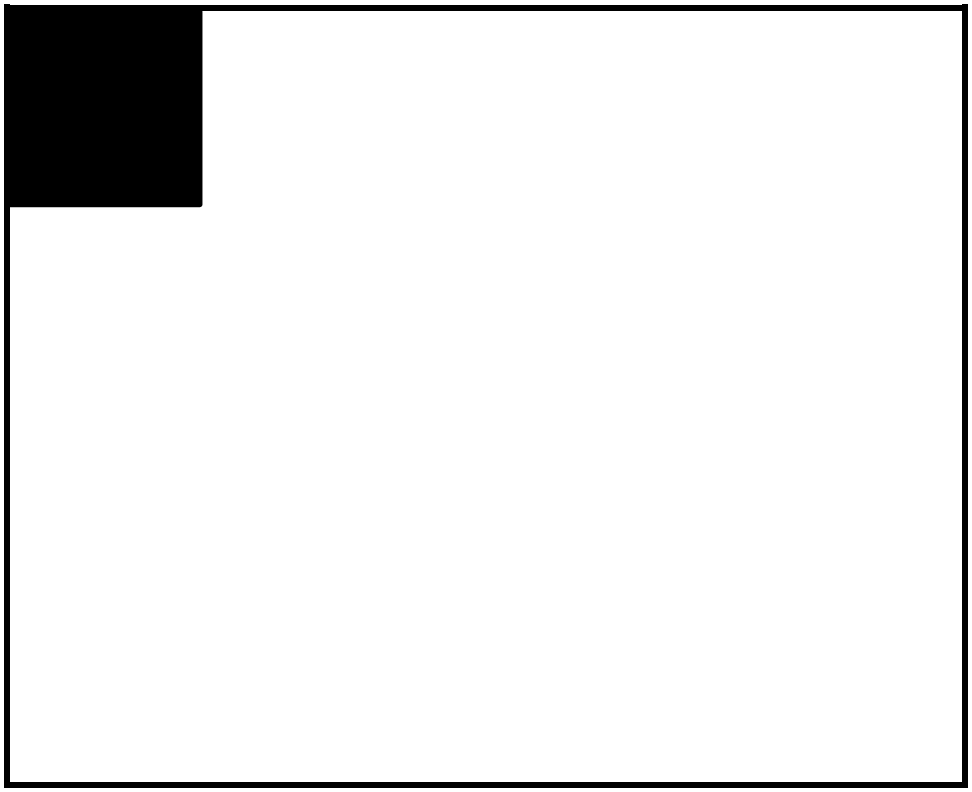
- Choose three situations from the Sort It Out activity sheet, complete the story by assigning measurements, and create a question that can be answered about the story.
- Students write a word problem for each of the three answers given in the Sort It Out activity sheet.

Strategies for Differentiation

- Have students create a scale model of the sandbox. Mark off a place in your classroom to tape the dimensions of the sandbox. Cut out a square for the plastic covering and a triangle for the seat from paper. Make a rectangular prism, possibly out of card stock or cardboard for the sandbag. Use these to tell the story of The Sandbox.
- Allow students to have a formula sheet when computing area, perimeter, and volume.
- Ensure vocabulary cards for area, perimeter, and volume are on display.
- Have geometric solids available for students to explore area, perimeter, and volume.

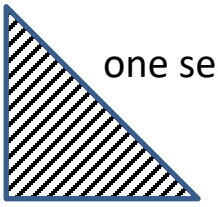
Note: The following pages are intended for classroom use for students as a visual aid to learning.

The Sandbox



one strip of wood

one piece of plastic



one seat

1) Estimate how many strips of wood are needed to make the frame of the sandbox.

2) Estimate how many pieces of plastic are needed to cover the bottom of the sandbox.

Sort It Out

Kim wanted to put a border of heavy ribbon around her rug in her bedroom.	Mrs. Lindsey needs to find a container to store the blocks in her room.
Leroy wants to cover his binder with heavy blue paper to protect it.	Jamil wants to make a picture with different colored sticky notes.
Dad is building a wooden frame for the speakers in the living room.	Tina wants to store her shoeboxes in a large drawer in her dresser.
Eva is putting silver, right triangles in the corner of her picture.	The answer is 36 square yards.
The answer is 24 cubic inches.	The answer is 48 kilometers.

Grid Paper