Grade 6 Rectangular prism volume

6.SS.3	
Develop and apply a formula for determining the • perimeter of polygons • area of rectangles • volume of right rectangular prisms	1. Explain, using models, how the perimeter of any polygon can be determined. [NOT DEVELOPED] 2. Generalize a rule (formula) for determining the perimeter of polygons. [NOT DEVELOPED] 3. Explain, using models, how the area of any rectangle can be determined. [NOT DEVELOPED] 4. Generalize a rule (formula) for determining the area of rectangles. [NOT DEVELOPED] 5. Explain, using models, how the volume of any right rectangular prism can be determined. [DEVELOPED] 6. Generalize a rule (formula) for determining the volume of right rectangular prisms. [DEVELOPED] 7. Solve problem involving the perimeter of polygons, the area of rectangles, and/or the volume of right rectangular prisms. [ONLY VOLUME PROBLEMS]

Clarification of the outcome:

- ✦ This outcome concerns a formula for a rectangular prism (a box). It involves multiplying the three dimensions of the prism (length x width x height).

Required close-to-at-hand prior knowledge:

- ✤ Understand volume as a count of identical cubes that fill an object.
- ✤ Understand the dimensions of a rectangular prism.
- ✤ Comfortable using cubic cm, cubic m, and liters (concepts from previous grades).

SET SCENE stage

The problem task to present to students:

Ask students to figure out a way to solve the following problem.

A camping water container is in the shape of a rectangular prism. The container is 40 cm long by 30 cm wide by 10 cm deep. How many litres of water can the container hold?

Comments

The task is difficult but open to low-level solution methods such as constructing a box out of cardboard and filling it with sand or some other measurable material.

DEVELOP stage

Activity 1: Revisits SET SCENE and addresses indicator 5.

- Ask selected students to describe the method used to solve or try to solve the SET SCENE task. Accept all responses. Do not indicate valid or not valid. Tell students we will return to the problem later on in the lesson after they have learned a formula for figuring out the volume of rectangular prism (a box).

Activity 2: Addresses achievement indicators 5 and 6.

- Organize students into groups. Provide a recording sheet. [See below.]

# of floors	Volume (cube count)	Length	Width	Height
1				
2				
3				
4				

- Provide each group with centimetre cubes and centimetre grid paper. Ask each group to draw a 2 x 3 rectangle on the grid paper. The rectangle serves as the base for a rectangular prism building. Tell students that they are going to construct a series of rectangular prism (box) buildings: 1 floor high, 2 floors high, 3 floors high, and 4 floors high on top of the 2 x 3 rectangle, using the 1 cm by 1 cm by 1 cm cubes. Ask them to count cubes to figure out the total volume of the building each time.
- Ask them to record the length, width, and height of each building. Ask them to think about the dimension numbers and the volume they obtained by counting cubes.
- Repeat the above for a 2 x 5 rectangle on the grid paper (this requires another recording sheet).
- Ask students if they see a short cut (a formula) for calculating the volume of a rectangular prism. Discuss their responses. [Suggest the formula of length x width x height if no student does.]

Activity 3: Addresses achievement indicators 5 and 6.

- Show students a hundreds flat (the hundreds place value material). Discuss the volume of flat. Ensure that students understand that its volume is 100 small cubes. Ask a volunteer student to build a box building using at least four flats. Discuss how the shortcut method/ formula could be used to calculate the volume of the building.
- Confirm the volume obtained by using the shortcut method (multiplying the three dimensions of the building) to that obtained by skip counting by 100 (e.g. for a 4 flat tall building, its volume is 100, 200, 300, 400 small cubes).

Activity 4: Addresses achievement indicators 5, 6, and 7.

- Organize students into groups. Provide each group with 20 one-centimeter cubes to construct box buildings.
- Ask them to construct three different box buildings that each have a volume of 20 cubic centimeters (e.g. 1 x 1 x 20, 1 x 4 x 5, 2 x 2 x 5). Ask them to determine the length, width, and height for each building and to confirm whether multiplying the three dimensions always results in a volume of 20 cubic centimeters. Discuss the results.

Activity 5: Addresses achievement indicators 6, 7, and practice.

- Organize students into groups. Provide each group with two different sized boxes (e.g. a Kleenex box and a playing card box) and 30 cm rulers.
- Ask students to measure and record the dimensions of each box (to the nearest centimetre) and to determine its volume in cubic centimetres. Discuss the results.

Activity 6: Revisits SET SCENE and addresses indicators 6 and 7.

- Ask students to determine the volume of the water container (from SET SCENE) using the formula. Ensure they obtain: 40 x 30 x 10 = 12 000 cc (cubic centimetres).
- Ask/remind students how many cubic centimetres there are in one litre. Ensure they realize 1000 cc = 1 litre.
- Ask them to figure out how many litres in 12 000 cc. Ensure they obtain: 12 000 ÷ 1 000 = 12 litres. Compare this result to any result obtained when they attempted the problem in the SET SCENE stage.

Activity 7: Assessment of teaching.

- Provide students with a small rectangular prism and a 30 centimetre ruler. Ask them to determine the volume of the prism in cubic centimetres.

If all is well with the assessment of teaching, engage students in PRACTICE (the conclusion to the lesson plan).

An example of a partial well-designed worksheet follows.

The worksheet contains a sampling of question types. More questions of each type are needed.

The MAINTAIN stage follows the sample worksheet.

Question 1.

a) A rectangular prism has a dimensions 4 cm x 2 cm x 8 cm. What is its volume?
_____

b) A rectangular prism has a dimensions 5 m x 6 m x 10 m. What is its volume?
_____

Question 2.

A toy building is made of small cubes. The building is in the shape of a rectangular prism. The building is 5 cubes wide, 10 cubes long, and 2 cubes high. What is its volume in cubes? _____

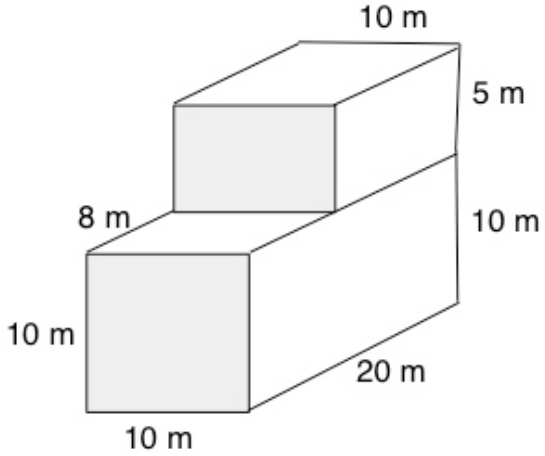
Question 3.

Fill in the missing numbers in the table.

Volume	Length	Height	Width
100	20	5	
60		2	2
80	10	2	
	5	6	12

Question 4.

Determine the volume of the building made by combining two rectangular prisms.



MAINTAIN stage

Mini-task example

Every so often:

- Present the dimensions of a rectangular prism. Have students calculate its volume.

Rich-task example

Provide students with 64 one-centimetre cubes. They use all of the cubes to build a rectangular prism. Have them determine the prism that has a volume of 64 cc and the smallest sum of its edges. [Note: Do not double count an edge.]

Have them record their work in a table such as the one here. Two entries are provided as examples.

Dimensions of prism	Volume of prism	Sum of edges
2 x 4 x 8	64 cc	56 cm
2 x 2 x 16	64 cc	80 cm

Comments

For information on 'edge', refer to: Faces, Edges, and Vertices

The prism that minimizes the sum of edges is a cube. The dimensions are 4 x 4 x 4. The volume is 64 cc and the sum of edges is 48 cm.