5E Lesson Plan - Volume of Prisms (12.2)

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Title of Lesson: Volume of Rectangular Prisms
Date of Lesson: 5 October 2012
Length of Lesson: 50 Minutes
Name/Level of Course: 6th grade, IB Pre-algebra

Why Is This Lesson Appropriate for Middle School Students?:
This lesson is middle school appropriate because it allows the student to have a hands on activity, appealing to their sensory needs, and also allows them the opportunity to work hands-on with their peers and share ideas.

Technology Lesson? No

Source of the Lesson:
Online Blog: "Runde's Room", 2012. Retrieved from
        http://www.rundesroom.com/search?q=volume
The National Council of Teachers of Mathematics, Illuminations, "Fill 'er up". Retrieved from

        http://illuminations.nctm.org/LessonDetail.aspx?id=L831

Concepts:
Volume is the the quantitative measurement of the capacity of a three-dimensional object. Understanding the concept of volume is important for everyday life because volume is everywhere around us. It is what fills the soda bottles, fills up the bathtub or swimming pool, and the amount of pumpkin in a can to make pumpkin pie. It can be defined by formulas for simple shapes, such as prisms, spheres, and cylinders. The calculations involve cubic units of measurement, for example cubic centimeters.

Objectives:
        1.) Students will be able to describe the formula for the volume of rectangular prisms.
        2.) Students will be able to apply the formula for the volume of rectangular prisms.
        3.) Students will be able to solve for missing length, width, and height with a given volume.

State Standards:

Benchmark Number:	MA.6.A.3.4
Benchmark Description:	Solve problems given a formula.
Subject Area:	NGSSS: Mathematics

Grade Level:	6
Body of Knowledge:	Algebra
Big Idea:	BIG IDEA 3 - Write, interpret, and use mathematical expressions and equations.

Benchmark Number:	MA.6.G.4.3
Benchmark Description:	Determine a missing dimension of a plane figure or prism given its area or volume and some of the dimensions, or determine the area or volume given the dimensions.
Subject Area:	NGSSS: Mathematics
Grade Level:	6
Body of Knowledge:	Geometry
Supporting Idea:	Geometry and Measurement - Geometry and Measurement

FACT Used: Create the Problem (#11)
       pg 80-81 from "Mathematics Formative Assessment" by Keeley and Tobey

Safety: There are no safety concerns.

Materials List and Advanced Preparations:

- 2 Pre-folded rectangular prisms (1 per group, one blue, one yellow)
- Centimeter cubes
- "Discovering Volume" Worksheet (1 per student)
- "Volume of Rectangular Prisms" Interactive notebook page (1 per student)

**See documents attached at end of lesson

Pre-Assessment Time: Prior to lesson		
What the Teacher Will Do	**Probing/Eliciting Questions**	**Student Responses and Misconceptions**
Give students pretest.		

Based on the results of pretest, modify the lesson as needed.		

ENGAGEMENT **Time: 5 Minutes**		
What the Teacher Will Do	**Probing/Eliciting Questions**	**Student Responses and Misconceptions**
Hold up a shoe box, a deck of cards, and a game box.	What do all of these items have in common?	They all have squares/rectangles. They all are all boxes.
Hold up a die. Write 'volume' on board.	How is this die the same as all of the other items I just showed you? How do we measure these? How do we know how much stuff these will hold? Does anyone know what that measurement is called? Who can tell me where the length of this object is measured? Who can tell me where the width is? (Sometimes called depth) Who can tell me where the height is?	It's not the same. It's a special rectangle. They all have a box shape. They all have 6 sides. With a ruler. (misconception) Weigh them. Put stuff in there. Fill it to the top. Area. (misconception) Volume. Along the bottom. Along the side. Along the bottom. Along the side. From the top to the bottom.

Draw a rectangular prism on the board with length, width, and height labeled.		

Transition Statement: Everyone had great ideas on how we can measure these items, let's do an activity now to explore how to measure the volume of rectangular prisms.

EXPLORATION Time: 20 Minutes		
What the Teacher Will Do	**Probing/Eliciting Questions**	**Student Responses and Misconceptions**
The teacher will pass out two folded, topless rectangular prisms, centimeter cubes, "Discovering Volume" worksheet, and "Volume of Rectangular Prisms" interactive notebook page. Place students in groups of two.		
The teacher will instruct the students to find the volume of the two topless boxes by using the centimeter cubes. Explain that the boxes were made from a regular size piece of paper. The blue box is a rectangular prism and the yellow is a cube. The students are to make predictions about what the volume of each box will be, before estimating the volume with the centimeter cubes.	How many cm cubes do you think will be needed to fill up this box? (Hold up one of the boxes) If the length of the volume was only half the length it is now, what would happen to the volume? How can you test to see if that is true? If the height was double the height it is now, what would happen to the volume?	Answers will vary. Test it. Fill the box up. The volume would be half what it is now. Fill only half of the box. Measure the length only half way down the box. The volume would be double what it is now.

	How can you test to see if that is true?	Measure the height twice as big before multiplying to find the volume.
	If the height and length are doubled, what would happen to the volume?	The volume would be four times greater.
	How can you test to see if that is true?	Measure the length and height twice as big before multiplying to find the volume.
Say: Now, I want you all to compare the dimensions (length, width, and height) and also compare the volume of the two boxes by working with your partner and answering the questions on your worksheet.

Demonstrate how to use the cm cubes to measure the length, width and height of folded prisms that were handed out. Explain that the cubes are 1cm by 1cm by 1cm.... so for example, stacking 3 on top of each other would equal 3cm. | | |
| Teacher walks around room to check progress and asks questions to uncover student thinking. | What did you come up with?

How do you get that response? | |

	Explain how/why you got this. Were your predictions correct? What is special about the yellow box?	

Transition Statement: There were a lot of good questions being asked in the activity, so let's hear some of them and talk about what we have figured out.

EXPLANATION **Time: 10 Minutes**		
What the Teacher Will Do	**Probing/Eliciting Questions**	**Student Responses and Misconceptions**
Ask for volunteers to explain how they got volume. The students will have their "Volume of Rectangular Prisms" Interactive notebook out Instruct them to take notes on their notebook page about the characteristics of a rectangular prism, the formula, etc. **The teacher will write on the board the group consensus of...** **"Characteristics of a rec. prism"**	What are some characteristics of a rectangular prism? Which dimensions can be	Length, width(depth), height

"What is volume?" On the interactive notebook	measured in a rectangular prism?	
	What do we find out about volume? Who can explain it in their own words?	Volume is the amount of cubes it takes to fill an object.
"What is the formula for finding the volume?" On the interactive notebook.	How do we calculate the volume of a rectangular prism?	Multiply the length, width and height.
	How can we write the volume of a prism in a formula?	V=lwh
Display the table from the worksheet so all students can see it. Ask for volunteers (or pull sticks) to put their solutions on the board and explain how they got it.	If you know the volume of a prism and you know the width and length, how can you determine the height? **(FACT)**	Divide the volume of the prism by the product of the width and length.
	If we are told that a cereal box is 2 inches wide, 6 inches long, and 10 inches tall, how much cereal can the box hold? **(FACT)**	The cereal box can hold 120 cubic inches of cereal.
Say: 'Thumbs up/Thumbs down' to see if students agree with their response or not. If any student disagrees, get their response and an explanation and come to an agreement on the correct solution.	What do we do if we know the volume if we don't know all the dimensions? **(FACT)**	Work backwards.
	Can we figure out the dimensions? How? **(FACT)**	Yes. We divide the volume by the product of the two known dimensions.
	What if the volume was $100cm^3$? $10cm^3$? $1cm^3$? what are some possible dimensions? How did you know that? **(FACT)**	Answers will vary. $1cm^3$ there may be misconceptions of it not being possible. 1x1x1, 10x1/2x1/5

Give an example of dimensions of a cube.	If the volume is 8in^3? 27in^3? 64in^3?, what are the dimensions? **(FACT)**	2x2x2in 3x3x3in 4x4x4in
Draw a rectangular prism on the board.	What did we say this was?	Rectangular prism. Rectangle box. Box. Cube.
Draw a cube of the board.	Who can tell me what this is?	Box. Cube.
"What defines a cube?" On the interactive notebook.	How are these 2 shapes alike? How are they different?	6 sides. Cube is a square. Sides are different, cube's sides are all the same.
Stress that a cube is a *special type* of rectangular prism.	What is special about the dimensions of a cube?	They are all the same.

Transition Statement: Now let's discuss how changing measurements affects the volume.

ELABORATION Time: 5 Minutes		
What the Teacher Will Do	**Probing/Eliciting Questions**	**Student Responses and Misconceptions**
The teacher will ask probing questions to help the students realize how changing the measurement of the length, width, and/or height affects the volume of a rectangular prism.	What happened in the activity when you doubled all of the dimensions of the rectangular prism? So, If the width and length of a prism double but the height stays the same, how will the	It doubled the volume. It quadruples. It gets 4 times as big.

	volume change?	
	What happened when we halved one of the dimensions in the activity?	The volume was half of what it was before.
	How will halving all three dimensions affect the volume of a prism?	It will get smaller. The new volume will be the eighth the volume of the original prism.

Transition Statement: Now we are going to take a quiz. It is the same quiz you have taken before, we just want to see how much you have learned.

EVALUATION Time: 10 Minutes		
What the Teacher Will Do	**Probing/Eliciting Questions**	**Student Responses and Misconceptions**
Collect all the worksheets & cubes from students. Instruct them to go back to their own seats. Distribute post-assessment to each student and instruct them to work independently. Allow 5-8 minutes to complete it.		

Discovering Volume

Name: _____

1. Using the centimeter cubes which were given to you, estimate the following dimensions of the **<u>blue box</u>** to the nearest whole centimeter.

       What is the length? _____ cm

       What is the width? _____ cm

       What is the height? _____ cm

 How many centimeter cubes will the blue box hold? _____

 What is the *volume* of the blue box? _____ cm^3

       Explain your reasoning:

2. Using the centimeter cubes, estimate the following dimensions of the **<u>yellow box</u>** to the nearest whole centimeter.

       What is the length? _____ cm

       What is the width? _____ cm

       What is the height? _____ cm

 How many centimeter cubes will the yellow box hold? _____

 What is the *volume* of the yellow box? _____ cm^3

       Explain your reasoning:

3. How do you think the volume of the **<u>blue box</u>** would change if the *height was tripled*?

Make a prediction:_____

Use your results from Question 1.

Length = _____ cm

Width = _____ cm

Height = _____ cm **X 3** = _____ cm

What is the new volume of the rectangular prism if the height is tripled? _____ cm^3

Explain your reasoning:

What did you discover about your prediction?

4. How do you think the volume of the **<u>yellow box</u>** would change if *<u>every dimension was doubled</u>*?

Make a prediction:

_____

Use your results from Question 2.

Length = _____ cm **X 2** = _____ cm

Width = _____ cm **X 2** = _____ cm

Height = _____ cm **X 2** = _____ cm

What is the new volume of the rectangular prism if every dimension is doubled?
_____ cm^3

Explain your reasoning:

What did you discover about your prediction?

5. Complete the chart below by filling in the missing values for the dimensions of a rectangular prism.

Length	Width	Height	Volume
3 in	5 in	2 in	
2 ft	4 ft		24 ft^3
5 yd		5 yd	125 yd^3
	6 cm	2 cm	120 cm^3
			64 cubic units

6. Find the volume of an object that is a rectangular prism that you use every day (if you cannot think of one, find a rectangular prism in the classroom) using the appropriate dimensions.

What is the object you are using? _____

Approximate **length**	Approximate **width**	Approximate **height**
_____ _____units	_____ _____units	_____ _____units

Draw a picture of your object:

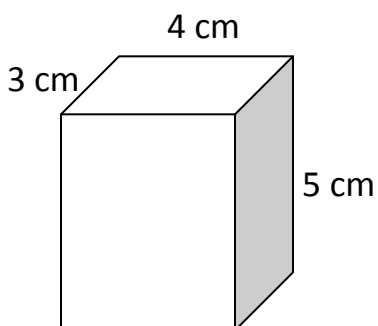What is the volume? Show all work.

Pre-Assessment (&Post-assessment)
21 September 2012
Ms. Chomat

Name: _____

1.) What dimensions are needed to calculate volume?

2.) Find the volume of the rectangular prism.

Show work here:

4 cm

3 cm

5 cm

A) 12 cm^3

B) 60 cm^3

C) 25 cm^3

D) 36 cm^3

3.) Draw a rectangular prism with a volume of 40 cubic centimeters.

Explain here:

Example of interactive notebook page: