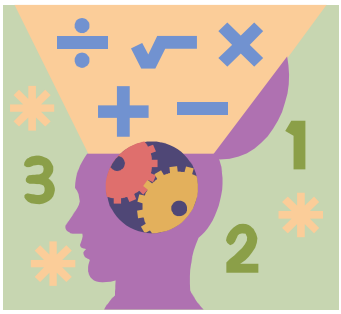
Algebra/Geometry Institute Summer 2009



Faculty Name: **Karen Harmon**

School: **Presbyterian Day School**
Cleveland, MS

Grade Level: **Fifth Grade**

1 Teaching objective(s)

- The student will develop measurement concepts and formulas through the use of geometry.
- The student will develop the measurement concept and formula for the volume of a rectangular prism.

2 Instructional Activities

The **volume** of an object is *the amount of space occupied by that object*. (Write the term and definition on the board and have the class read it with you.) It is important to know the size of a thing before trying to get it through a narrow doorway, right? If it is too big it might not go through the door. Today we are going to measure how much space these boxes take up by filling them with 1 inch cubes. (Give each group an empty box and bin of 1 inch cubes.)

Activity One

Before you begin, make a prediction of the number of cubes it is going to take to fill this box. (Write each group's prediction on the whiteboard.) What strategy did you use to make your prediction? (List all ideas.) Which box do you think has the largest volume? (Record votes.)

Work with your group to cover the bottom of the box with one layer of cubes then stop. If there is a little space left but not enough for another cube, round to the nearest cube. In other words, if there is space after cube 4 but not enough for cube 5, count that as 4. When you have finished, count the cubes. Do you have any questions? Begin. (Monitor progress of groups to make sure they understand rounding to the nearest cube.)

Ask:

- How many cubes did it take?
- Did you have to count every cube or did you find a pattern to use as a shortcut?
- Can you describe the pattern? (array)
- Which operation did you use to find the total number so far? (multiplication or addition)

This is the *footprint* of the box or the amount of *surface* it covers. What is the math word for this amount of space? (Elicit the word "**area**.") What was the formula we learned to calculate area? (length times width or L x W) Remember, we express area in **square** units, and you can see all of that at work when you look at the **tops of the blocks**. When do we use area? (carpet or tile installation, sod for your yard)

Now that we know the **area of the footprint** of your boxes, does any group want to change its prediction about the TOTAL number of cubes it will take to fill the box for its **volume**? (If so, ask the reason for the change.) Which box do you think is the biggest now? Why?

Continue filling the shoebox with the 1 inch cubes. (Monitor groups again, listening for discovery of concept.)

Ask:

- How many cubes did it take for your box? (Write the actual numbers beside the predictions.)
- Can we place the boxes in order from least to greatest? (Rank them.)
- Which prediction was the closest?
- Was one estimating strategy better than another?
- Did you come up with new strategies as you went along or did you have to wait until the end and count the blocks?
- Who can describe in words how we could calculate the volume without filling a box with blocks every time? (Take multiple expressions. Lead them to the term *height* for the number of layers of blocks.) "**Height" is how high something is or the measurement from top to bottom.** (Write the term and definition on the board and have the class read it with you.)

If we use the terms we already know ***length*** *(how long something is*) and ***width*** *(how wide across something is*) and our new term (***height*****)** can anyone come up with a formula that would work for every rectangular box? (L x W x H). Check the arrangement of cubes in your boxes. Would it have worked for you? You have discovered the correct formula for the volume of a rectangular prism. (Write the formula on the board and have the class read it with you.)

We express volume in **cubic** units. (Show a cube.) Can you see why? There are 3 dimensions: length, width, **and height**. The cube has all three. The cube is a **solid** figure. For area we measure in **square** units. (Show a square.) The square is a **plane** figure. It has only two dimensions—length and height. (Show a square.) We used **area** for laying carpet in our homes. How would we use **volume**? (Can I fit the wide screen TV box in the trunk of my car? Will the watermelon fit in the refrigerator or do I have to cut it in half?)

Activity Two

Do you think that two different boxes could have the same volume? Let's find out. I'm going to give each group a number to use. Take that many cubes and make as many shapes of rectangular prisms as you can think of. Leave all the

shapes side by side on the table. Use the LxWxH formula to make sure they have the same volume. (Monitor for understanding, redirecting if necessary.)

Ask:

- Is it possible for different shapes to have the same volume?
- Do the rectangular prisms have to look alike to have the same volume?

Good work today everybody. Please clear off your tables, putting the cubes in the tubs. While I collect the materials, please copy the terms and definitions from the board and the formula for finding the volume of a rectangular prism. Then, explain how volume is different from area. I'll be reading them to make sure everyone understands what we did today.

3 Materials and Resources

- tubs of one-inch square cubes
- empty rectangular containers of different sizes (shoeboxes, file folder boxes etc.)
- sample of cube and square
- white board and markers
- math journals and pencils
- http://www.teachers.ash.org.au/jeather/maths/dictionary.html An online dictionary of mathematical terms for kids.
- Attachment 1 (teacher created assessment, © Karen Harmon 2009)

4 Assessment

- During questioning, the teacher will monitor the growth of student understanding by their responses to questions and reasoning.
- During the activities, the teacher will observe group work for understanding and correct application of concepts.
- Student journal entries will reveal if students understood the concept.
- Written assessment will be a teacher-made test. (Attachment 1)

Written Assessment

1. A rectangular box is filled with l inch cubes. The first layer of cubes is an array of 3 rows with 5 cubes in each row. The box is filled with four of these layers. What is the volume of the box ?

    a. 32 cubic inches
    b. 60 cubic inches
    c. 12 cubic inches
    d. 19 cubic inches

2. A rectangular prism measures 6 inches x 3 inches x 2 inches. What is the volume?

    a. 11 cubic inches
    b. 20 cubic inches
    c. 18 cubic inches
    d. 36 cubic inches

3. Get 18 blocks from the tub at the front. Make them into 2 different shapes that have the same volume then describe these shapes.

    Shape I

    Shape II

4. Volume = L x W x H What does **H** stand for?

5. Why do we call the units of volume **cubic** units?

Answer Key

1. b - 60 cubic inches

2. d - 36 cubic inches

3. There could be three layers of cubes in a 2 x 3 array (3 cubes long, 2 cubes wide, 3 cubes high)

   There could be two layers of cubes in a 3 x 3 array (3 cubes long, 3 cubes wide, 2 cubes high)

4. **"H "**stands for **height**, how tall a figure is. You measure from the top to the bottom of a figure.

5. We measure volume with cubes because a cube has **three** dimensions of equal size: **length, width, and height**. The answer to a volume problem is expressed in cubic units. A square only shows two dimensions, length and width.