



To Err is Human

Lesson Plan for Grades: 5th Length of Lesson: 45 minutes
Authored by: UT Environmental Science Institute Date created: 07/13/2022
Subject area/course: <ul style="list-style-type: none">Mathematics, 5th Grade
Materials: <ul style="list-style-type: none">50 counting blocks per group of 3-4 students (preferably of the kind that can connect).Plastic bags.
TEKS/SEs: <p><i>5.6 Geometry and measurement. The student applies mathematical process standards to understand, recognize, and quantify volume.</i></p> <ul style="list-style-type: none">5.6(A) recognizes a cube with a side length of one unit as a unit cube having one cubic unit of volume and the volume of a three-dimensional figure as the number of unit cubes (n cubic units) needed to fill it with no gaps or overlap if possible5.6(B) determine the volume of a rectangular prism with whole-number side lengths in problems related to the number of layers times the number of unit cubes in the area of the base <p><i>5.4(G) use concrete objects and pictorial models to develop the formulas for the volume of a rectangular prism, including the special form for a cube ($V = l \times w \times h$, $V = s \times s \times s$, and $V = B \times h$)</i></p> <p>Note: Students should have already learned how to find the area of a square and rectangle.</p>
Lesson objective(s): <ul style="list-style-type: none">Students will be able to formulate how to calculate volume using counting blocks.Students will be able to associate length, width, and height.
Differentiation strategies to meet diverse learner needs: <ul style="list-style-type: none">The teacher should assign groups based on who complements one another best. Emphasize collaboration to help everyone within the group understand.The teacher should walk around to make sure every group is on task and answer any questions that arise.
ENGAGEMENT (5 minutes) <p>The teacher will use images of real-life examples in which cubes and rectangular prisms are prevalent. Sample images are included in the <i>Student Engagement Handout</i>. Allow for 5-10 seconds between each picture shown to allow students time to think.</p> <ul style="list-style-type: none">Ask: What do they notice about the pictures shown? Can they notice the similarities and differences between each? What do you know about rectangles and squares already?Use what students already know about rectangles and squares to have them recall the area of both shapes. The teacher draws a square and rectangle that the entire class can see and encourages students to share how to find the area for both shapes.Pose the question: "How would you find the number of cubes or water you'd be able to fit inside one of these shapes."



To Err is Human

EXPLORATION (12 minutes)

1. Create groups of 3-4 students.
2. The students will be asked to build certain cubes and rectangular prisms themselves (see the *Exploration Handout* for suggestions or you can prepare your own). Have samples of the shapes pre-built and ready to show to the class as a demo. Emphasize that you want each group to recreate the shapes you are showing.
3. The teacher must walk around the class and make sure all groups are still on task.
4. To get the students thinking about volume, the teacher may ask students to come up with a way to calculate the total amount of unit blocks as quickly as possible.
 - a. "What's the quickest way to find the total amount of blocks in your shape?"
 - b. "What if you were to combine cubes and rectangular prisms? How would you find the total amount of cubes in your new shape without counting every single block?"

Note: The teacher must refrain from mentioning how there only exactly one way to find the total amount of cubes.

EXPLANATION (5 minutes)

Have every group share their process for calculating the total number of cubes. The teacher should listen to all of their explanations and see if they are able to apply concepts to the student's explanations.

- "What if you were able to split up your shape into multiple rectangles and squares?"
- "Could the area be used somehow?"

Let the students ponder this for 2-3 minutes. Then, have them talk to their neighbor for 2 minutes to share their ideas. Prolong the formulaic explanation as much as possible for the students to struggle.

ELABORATION (23 minutes)

1. The teacher should introduce length, width, and height using the unit blocks (pre-built shapes).
2. Start with length and width while having the students think about the area of the shape. Show them a two-dimensional square and rectangle. Using what they know about the area of a square and rectangle, ask about how they would find the area of the square or rectangle. A 3×3 , 3×5 , etc. may be used.
 - a. Show them that the area they found is essentially the total amount of cubes they have when looking at the shape face up. Make sure to mention this.
3. Ask "We know how to find the area of a rectangle or square. If we were to stack the same shape on top. Wouldn't we be multiplying the same area twice, three times, four...?"
 - a. As you state the question, use the blocks to duplicate the shape you asked the students to find the area for. Introduce the concept of height by doing this. Thus, bringing all three dimensions together to introduce the concept of volume, but refrain from bringing the formula out.



To Err is Human

4. Hand the students the *Elaboration Student Handout* with the two shapes they have to solve for. Give them 4 minutes to solve for each of them.
5. After the time is up, reveal the answer. Tell them that the purpose of the lesson was not for them to be able to solve such a problem right away. It was for them to struggle with the concept and attempt a problem without being given a direct way to solve it.
6. Show Dr. Bob Duke's *Hot Science at Home* (29:00-30:10 <https://youtu.be/vwFbqHXy8rc?t=1740>) on how it's important to struggle with whatever you are learning about. How it is okay to get things wrong and to learn from them. Make this more of a life lesson that happens to be math-related.

EVALUATION (throughout the entire lesson)

- The teacher will walk around the class and evaluate based on students' participation and if they attempted to solve the problem in the elaboration.
- For a summative assessment, make copies of the *Evaluation Student Handout* with the rectangular prism depicted and have them label length, width and height, as well as, solving for the volume of that shape.

SOURCES AND RESOURCES

- Dr. Bob Duke, *Hot Science at Home* #1.10, "**To Err is Human**", <https://www.esi.utexas.edu/talk/err-human/>
- Image: "Artificial ice cubes", https://commons.wikimedia.org/wiki/File:Ice_cubes_openphoto.jpg#/media/File:Ice_cubes_openphoto.jpg
- Image: "Nintendo-GameCube-Console" <https://commons.wikimedia.org/wiki/File:Nintendo-GameCube-Console-BR.jpg#/media/File:Nintendo-GameCube-Console.jpg>
- Image: "Prism Studios", https://commons.wikimedia.org/wiki/File:Prism_Studios,_Leeds_001.jpg#/media/File:Prism_Studios,_Leeds_001.jpg
- Image: "The Wii Console by Nintendo. Featured with the Wiimote." <https://commons.wikimedia.org/wiki/File:Wii-console.jpg#/media/File:Wii-console.jpg>



To Err is Human

ENGAGEMENT HANDOUT



Image Source: Artificial Cubes, Creative Commons



Image Source: Nintendo GameCube, Creative Commons



Image Source: Prism Studios, Creative Commons



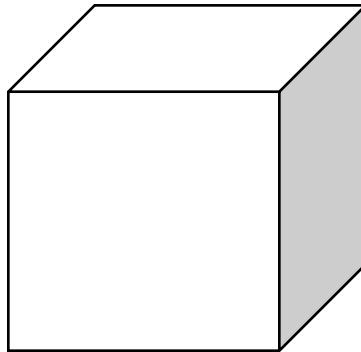
Image Source: Nintendo Wii, Creative Commons



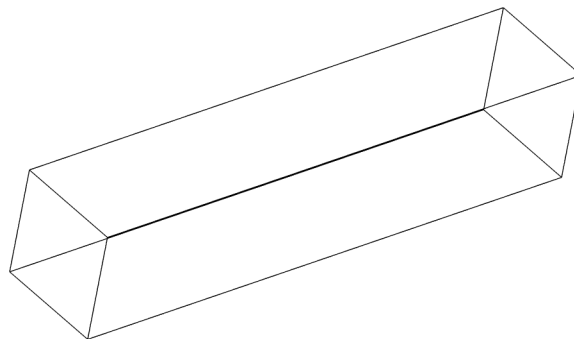
To Err is Human

ELABORATION STUDENT HANDOUT

1. Looking at this cube. With a length, width, and height of 4 centimeters, what is the volume of this shape?



2. What is the volume of this rectangular prism with a length of 6 centimeters, a width of 4 centimeters, and a height of 7 centimeters?

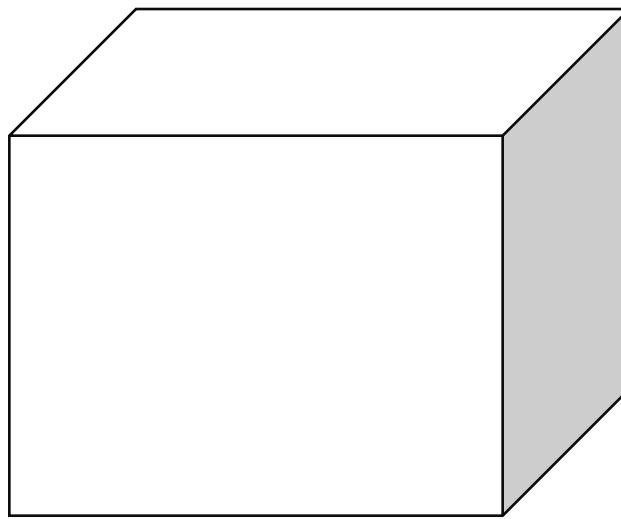




To Err is Human

EVALUATION STUDENT HANDOUT:

1. Looking at this cube. Label the length, width, and height of this shape. With the dimensions of 5 cm for length, 5 centimeters for width, and 6 centimeters for height, is this shape a cube or rectangular prism? Solve for the volume of this shape and show work.





To Err is Human

ANSWER KEY/RUBRIC

ELABORATION STUDENT HANDOUT:

1. 64 cm^3
2. 160 cm^3

EVALUATION STUDENT HANDOUT AND RUBRIC:

1. Rectangular Prism/ 150 cm^3

Labeling the dimensions of the figure correctly. (Partial Credit)	4 points
Being able to identify the shape correctly.	2 Points
Solving for volume correctly. (Partial Credit)	6 Points
Total	12 Points