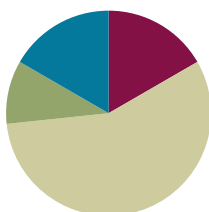


Lesson 1

Objective: Explore volume by building with and counting unit cubes.

Suggested Lesson Structure

■ Fluency Practice	(10 minutes)
■ Concept Development	(34 minutes)
■ Application Problem	(6 minutes)
■ Student Debrief	(10 minutes)
Total Time	(60 minutes)



Fluency Practice (10 minutes)

- Multiply Whole Numbers Times Fractions Using Two Methods **5.NF.4** (5 minutes)
- Find the Area **4.MD.3** (5 minutes)

Multiply Whole Numbers Times Fractions Using Two Methods (5 minutes)

Materials: (S) Personal white board

Note: This fluency activity reviews Module 4 content.

T: (Write $\frac{1}{2} \times 12 = \frac{\quad \times \quad}{2}$.) On your personal white board, write the complete number sentence.

S: (Write $\frac{1}{2} \times 12 = \frac{1 \times 12}{2}$.)

T: (Write $\frac{1}{2} \times 12 = \frac{1 \times 12}{2} = _ = _$.) Fill in the missing numbers.

S: (Write $\frac{1}{2} \times 12 = \frac{1 \times 12}{2} = \frac{12}{2} = 6$.)

T: (Write $\frac{1}{2} \times 12 = \frac{1 \times 12}{2}$.) Let's try another way. Divide by a common factor, and solve.

S: (Write $\frac{1}{2} \times 12 = \frac{1 \times \cancel{12}^6}{\cancel{2}_1} = 6$.)

T: Did you get the same answer using both methods?

S: Yes.

Continue with the following possible sequence: $16 \times \frac{1}{4}$, $16 \times \frac{3}{4}$, $\frac{2}{3} \times 9$, and $24 \times \frac{5}{6}$.

Find the Area (5 minutes)

Materials: (S) Personal white board

Note: Reviewing this Grade 4 concept prepares students to explore volume.

T: (Project a 4-inch by 2-inch rectangle.)
Name the shape.

S: Rectangle. → Parallelogram.
→ Quadrilateral.

T: (Write $__ \text{ in} \times __ \text{ in} = __ \text{ in}^2$.) This shape is a rectangle, though we could also call it a *quadrilateral* or *parallelogram*. On your personal white boards, write the area of the rectangle as a multiplication sentence starting with the length of the longest side.

S: (Write $4 \text{ in} \times 2 \text{ in} = 8 \text{ in}^2$.)

T: (Project a square with side lengths of 5 cm.) Name the shape.

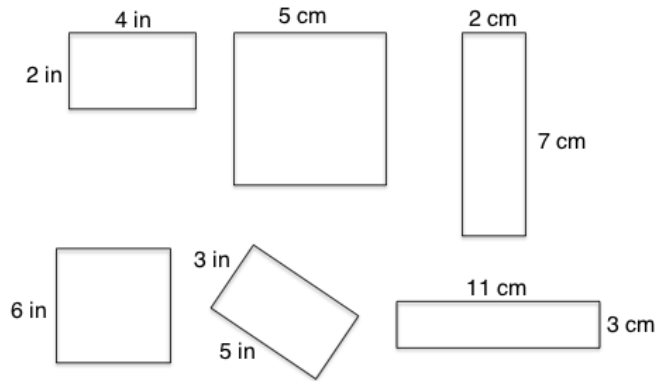
S: Square. → Rhombus. → Quadrilateral. → Parallelogram.

T: This shape is a square, but it is also correct to call it a *rhombus*, *quadrilateral*, or *parallelogram*. What is the measure of one of the square's sides?

S: 5 centimeters.

T: (Write $__ \text{ cm} \times __ \text{ cm} = __ \text{ cm}^2$.) On your boards, write the area of the square as a multiplication sentence using the measure of the square's sides.

S: (Write $5 \text{ cm} \times 5 \text{ cm} = 25 \text{ cm}^2$.)



Continue this process for the other squares and rectangles.

Concept Development (34 minutes)

Materials: (T) 20 centimeter cubes (S) Ruler, 20 centimeter cubes, centimeter grid paper (Template 1), isometric dot paper (Template 2)

Problem 1: Build a solid from cubes.

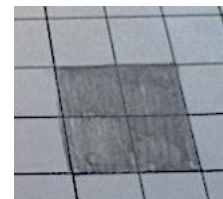
T: Shade a square on your centimeter grid paper with an area of 4 square units. (Pause to allow students to do this.)

T: This is going to be the foundation for our structure. Place 4 cubes directly on top of that square.

S: (Do so.)

T: Think of the first 4 cubes as the ground floor of a building. Make a second floor by putting another 4 cubes on top of them. (Pause.) How many cubes are there now?

S: 8 cubes.



- T: Did we change the ground floor? Why or why not? Turn and talk.
- S: No. We just built on top of it. → The second layer of cubes doesn't make it take up more space on the ground. → We built up, not out, so the structure got taller, not longer or wider.
- T: Put one more layer of 4. (Pause.) Explain to your partner how you know the total number of cubes.
- S: I just counted up from 8 as I put each cube. → Each floor had 4 blocks, so it's 3 fours. → I thought of 3 times 4, 12.
- T: What is the total number of cubes in your solid?
- S: 12 cubes.

Problem 2: Build solids with a given volume with cubic centimeters.

- T: Since this is a cube with each edge measuring 1 centimeter, we call this a **cubic centimeter**.
- T: (Hold up a centimeter cube.) These cubes can serve as a unit to measure the **volume** of your solid, the amount of space it takes up. What do we call this unit?
- S: A cubic centimeter.
- T: Just like we use squares to measure area in square units, we use cubes to measure volume in cubic units. (Write cubic unit, cubic centimeter, and cm^3 on the board.)
- T: (Hold up 2 cubes.) How many cubes?
- S: 2 cubes.
- T: How many cubic centimeters?
- S: 2 cubic centimeters.
- T: (Hold up 4 cubes in a square formation.)
- T: What is the volume of these 4 units together?
- S: 4 cubic centimeters.
- T: Work with a partner. On your grid paper, build three different solids with a volume of 4 cubic centimeters.

Give students time to build the structures. Move on to do likewise with five and then six cubes as time allows. While circulating, encourage students to use the words *volume* and *cubic centimeters* when answering questions.

Problem 3: Represent solids on isometric dot paper.

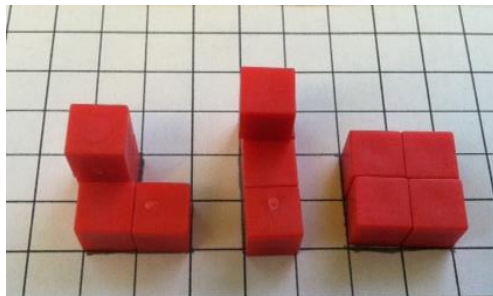
- T: We are going to build some other structures, but we want to draw what we build. Let's learn how to use our isometric dot paper to draw our structures.
- T: We will start by drawing 1 cube. (Demonstrate while directing students in each step.)



**NOTES ON
MULTIPLE MEANS
OF REPRESENTATION:**

If only 1-inch cubes are available, adapt the lesson to work with 1-inch cubes. Try to obtain 1-inch grid paper from the Internet, or create it on the computer and print it for students to use.

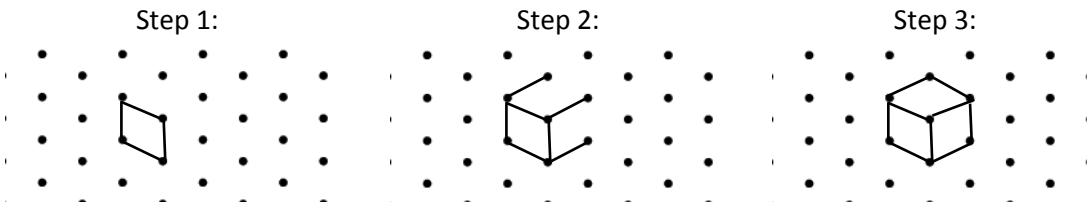
Possible Solutions



MP.4

Explain the process for drawing 1 cubic centimeter using the dot paper.

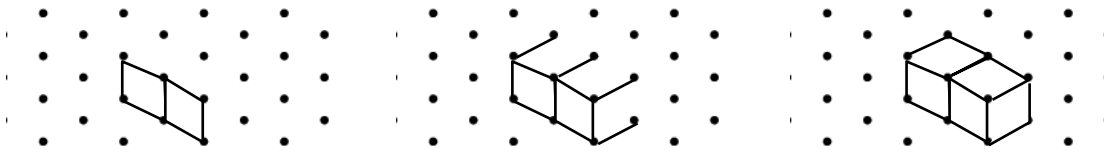
- Step 1: Connect four dots to make a parallelogram. This will represent one square face of the cube, viewed at an angle.
- Step 2: Draw three straight segments to the right from the two vertices on the top and the one on the bottom right.
- Step 3: Draw two segments to represent the missing edges.



T: Now we will put two cubes next to each other.

Explain the process for drawing 2 cubic centimeters.

- Step 1: Connect four dots to make a parallelogram.
- Step 2: Add another parallelogram that shares its right edge, just like your cubes.
- Step 3: Draw four straight segments to the right from the three vertices on the top and the one on the bottom right.
- Step 4: Draw three segments to represent the missing edges.



Allow students to practice several times. Then, choose examples of several students' work to show the class.

T: With a partner, build a structure with no more than 10 cubes each. Then, draw your partner's structure on dot paper. Help each other figure out if it matches what you built.

Circulate and help students draw their figures. When they are comfortable with the process, move them to the Application Problem and Problem Set.



**NOTES ON
MULTIPLE MEANS
OF ENGAGEMENT:**

The spatial reasoning required to draw centimeter cubes on isometric dot paper may be difficult for some students. Pattern block rhombuses may help students orient their drawings. Three rhombuses may be laid on paper (with or without dots) and traced to draw a cube.

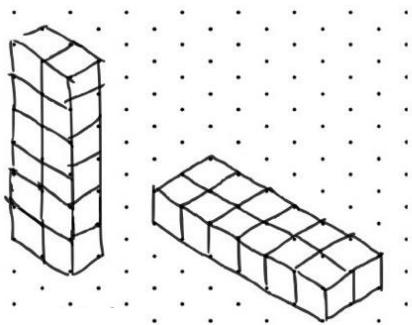
Students may also trace the yellow hexagon block and simply add three interior lines to create the cube.

Application Problem (6 minutes)

Jackie and Ron both have 12 centimeter cubes. Jackie builds a tower 6 cubes high and 2 cubes wide. Ron builds one 6 cubes long and 2 cubes wide.

Jackie says her structure has the greater volume because it is taller. Ron says that the structures have the same volume.

Who is correct? Draw a picture to explain how you know. Use grid paper if you wish.



Jackie's tower has 12 cubes.

Ron's tower has 12 cubes.

Ron is correct because both have 12 cubic units of volume. Ron's is just like Jackie's but lying down.



NOTES ON MULTIPLE MEANS OF ENGAGEMENT:

Consider what students see written on the board or projected on a screen:

- At different times of the day, walk around the classroom to become aware of light patterns in the room and how sunlight affects the visibility of white boards.
- Students who are trying to process new or challenging information can benefit if the written or projected material is neat and precise. Therefore, be mindful to always practice writing clearly and legibly.

Note: This Application Problem is intended to help students synthesize the parts they have learned in the lesson and build understanding toward subsequent lessons, where eventually they learn the formula for the volume of a rectangular prism.

Problem Set (10 minutes)

Students should do their personal best to complete the Problem Set within the allotted 10 minutes. Some problems do not specify a method for solving. This is an intentional reduction of scaffolding that invokes MP.5, Use Appropriate Tools Strategically. Students should solve these problems using the RDW approach used for Application Problems.

Lesson 1 Problem Set 5•5

Name Kenny Date 5-18

1. Use your centimeter cubes to build the figures pictured below on centimeter grid paper. Find the total volume of each figure you built, and explain how you counted the cubic units. Be sure to include units.

A.

B.

C.

D.

E.

F.

Figure	Volume	Explanation
A	1 cm ³	I just counted one cube.
B	5 cm ³	I added 3 cubes and 2 cubes.
C	9 cm ³	I multiplied 3 layers x 3 cubes.
D	9 cm ³	I counted the front layer, then carefully counted the back.
E	12 cm ³	I counted the end layer (4 cubes), and then multiplied by 3.
F	20 cm ³	I counted the bottom layer, and then multiplied by 2. 10 x 2 = 20

COMMON CORE Lesson 1: Explore volume by building with and counting unit cubes. Date: 4/24/14 engageNY 5.A.9

For some classes, it may be appropriate to modify the assignment by specifying which problems students should work on first. With this option, let the purposeful sequencing of the Problem Set guide the selections so that problems continue to be scaffolded. Balance word problems with other problem types to ensure a range of practice. Consider assigning incomplete problems for homework or at another time during the day.

Student Debrief (10 minutes)

Lesson Objective: Explore volume by building with and counting unit cubes.

The Student Debrief is intended to invite reflection and active processing of the total lesson experience.

Invite students to review their solutions for the Problem Set. They should check work by comparing answers with a partner before going over answers as a class. Look for misconceptions or misunderstandings that can be addressed in the Debrief. Guide students in a conversation to debrief the Problem Set and process the lesson.

Any combination of the questions below may be used to lead the discussion.

- In Problem 1, compare your answers for Figures C and D. What patterns do you notice?
- Compare your answers to Problem 2 with a partner. How were your drawings the same? Different?
- What was Joyce’s mistake in Problem 3? What do you need to think about when counting cubic centimeters in drawings? How is it different from counting them in person? Is it possible for a drawing to fool you? Might some cubes be hidden, or might there be gaps that you cannot see?

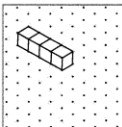
Exit Ticket (3 minutes)

After the Student Debrief, instruct students to complete the Exit Ticket. A review of their work will help with assessing students’ understanding of the concepts that were presented in today’s lesson and planning more effectively for future lessons. The questions may be read aloud to the students.

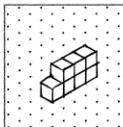
Lesson 1 Problem Set 5•5

2. Build 2 different structures with the following volumes using your unit cubes. Then, draw one of the figures on the dot paper. One example has been drawn for you.

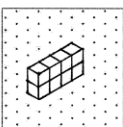
a. 4 cubic units



b. 7 cubic units




c. 8 cubic units



3. Joyce says that the figure below, made of 1 cm cubes, has a volume of 5 cubic centimeters.

a. Explain her mistake.

Joyce is not counting the one that is hidden. The cube that's on the second layer needs to be sitting on a hidden cube.



b. Imagine if Joyce adds to the second layer so the cubes completely cover the first layer in the figure above. What would be the volume of the new structure? Explain how you know.

The volume would be 10 cm³. I counted the first layer, and then multiplied by 2.

$$5 \text{ cm}^3 \times 2 = 10 \text{ cm}^3$$

COMMON CORE Lesson 1: Explore volume by building with and counting unit cubes. Date: 8/1/15 engage^{ny} 5.A.10

Name _____

Date _____

1. Use your centimeter cubes to build the figures pictured below on centimeter grid paper. Find the total volume of each figure you built, and explain how you counted the cubic units. Be sure to include units.

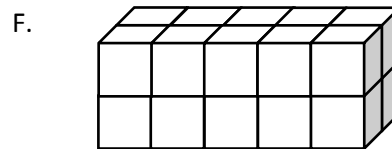
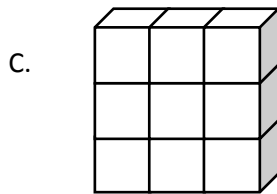
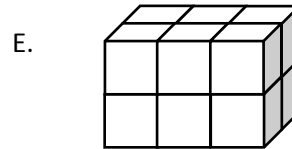
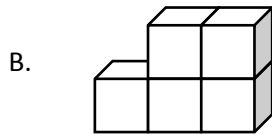
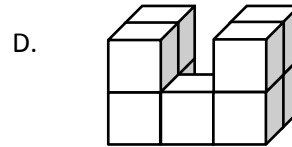
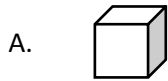
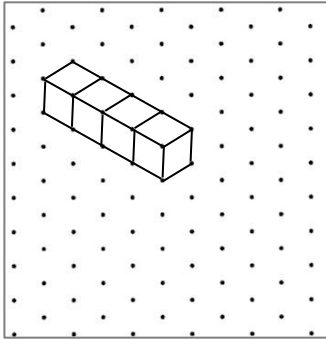


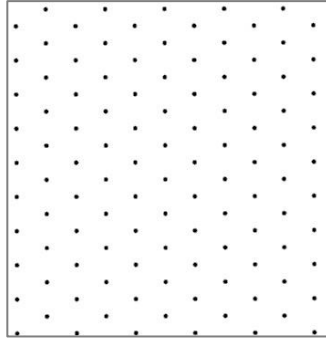
Figure	Volume	Explanation
A		
B		
C		
D		
E		
F		

2. Build 2 different structures with the following volumes using your unit cubes. Then, draw one of the figures on the dot paper. One example has been drawn for you.

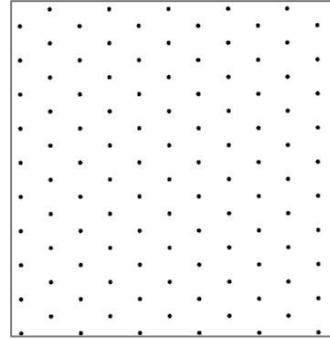
a. 4 cubic units



b. 7 cubic units

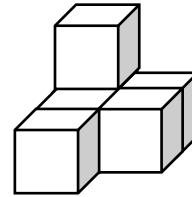


c. 8 cubic units



3. Joyce says that the figure below, made of 1 cm cubes, has a volume of 5 cubic centimeters.

a. Explain her mistake.

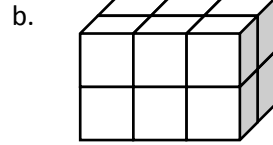
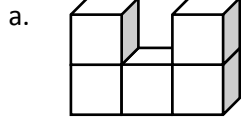


- b. Imagine if Joyce adds to the second layer so the cubes completely cover the first layer in the figure above. What would be the volume of the new structure? Explain how you know.

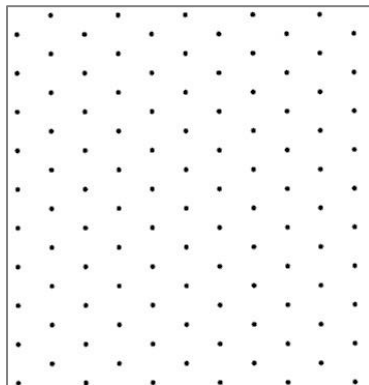
Name _____

Date _____

1. What is the volume of the figures pictured below?



2. Draw a picture of a figure with a volume of 3 cubic units on the dot paper.



Name _____

Date _____

1. The following solids are made up of 1 cm cubes. Find the total volume of each figure, and write it in the chart below.

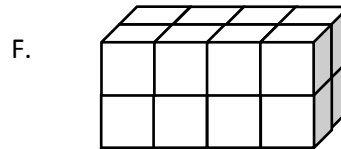
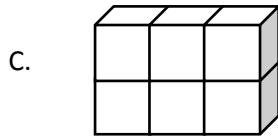
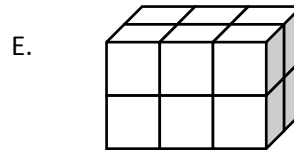
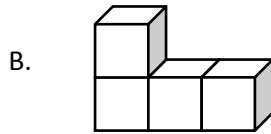
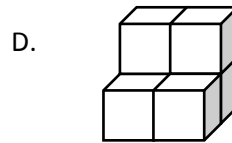
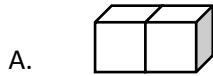
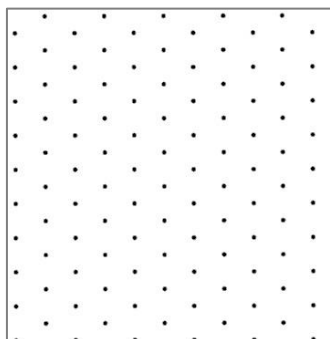


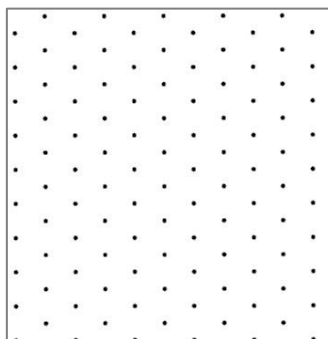
Figure	Volume	Explanation
A		
B		
C		
D		
E		
F		

2. Draw a figure with the given volume on the dot paper.

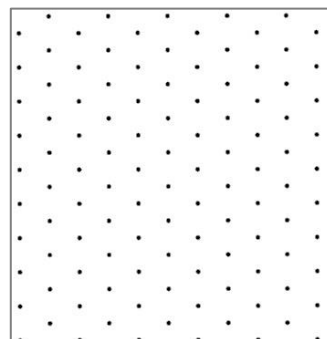
a. 3 cubic units



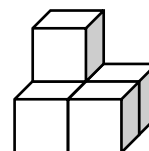
b. 6 cubic units



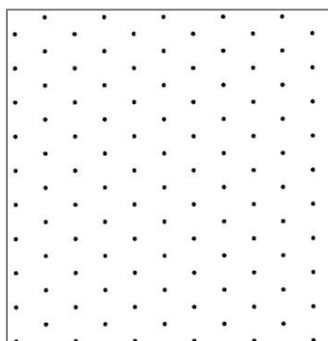
c. 12 cubic units

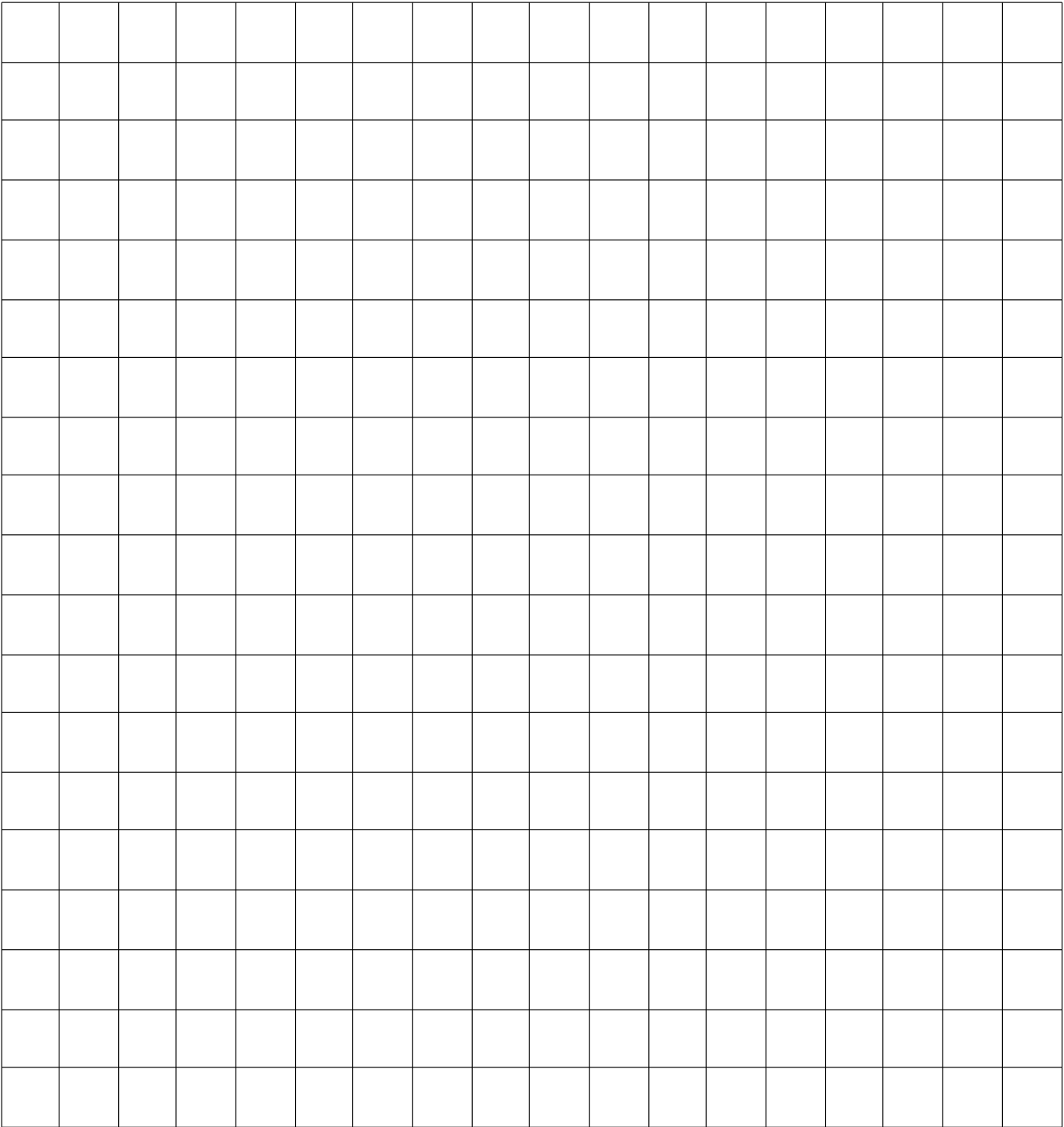


3. John built and drew a structure that has a volume of 5 cubic centimeters. His little brother tells him he made a mistake because he only drew 4 cubes. Help John explain to his brother why his drawing is accurate.

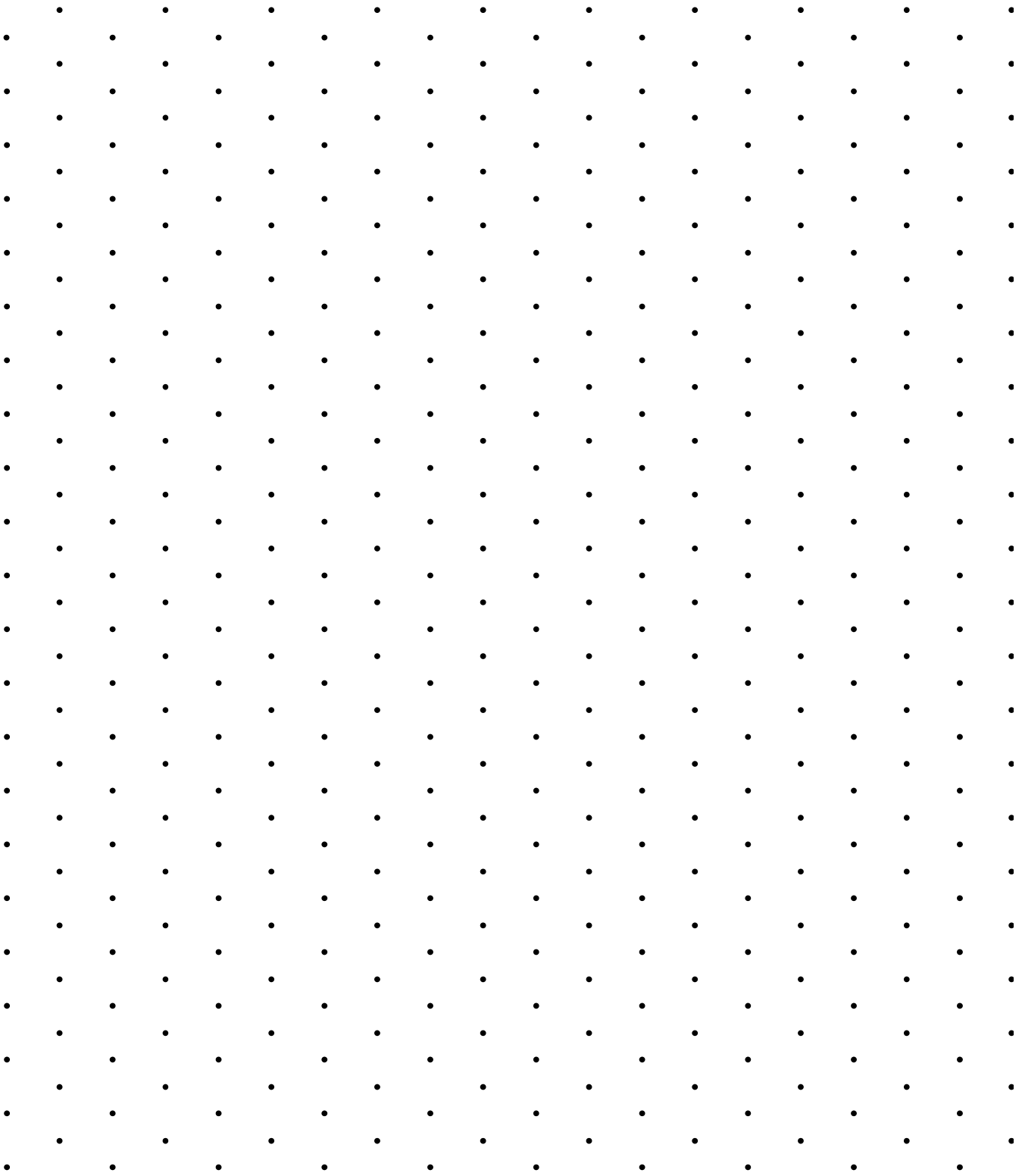


4. Draw another figure below that represents a structure with a volume of 5 cubic centimeters.





centimeter grid paper



isometric dot paper