How Much Space Is Inside?

Teacher		**Class**	Grade 5
Subject	Math	**Topic**	Understanding volume
Date		**Room**	
Lesson length	60 minutes	**Country**	United States

Students learn that volume is space inside solid figures. They pack boxes with unit cubes and compare volumes.

Curriculum links

- Understand volume as a measure of capacity and provide examples [1]
- developing an understanding of volume [2]

Learning objectives

- Students will recognize volume as space inside solid figures.
- Students will measure volume by counting unit cubes with no gaps.
- Students will compare two solids by volume in cubic units.

Success criteria

- I can tell what volume means for a solid.
- I can measure space by counting unit cubes.
- I can compare which solid has greater volume.

What students already know

Hold up a flat square and a small box. Ask: Which one has length, width, and height, and which one could hold cubes?

Key words

volume	how much space is taken up inside an object [4]
solid figure	an object that has length, width, and height [11]
unit cube	one tiny block used to measure space inside [9]
cubic centimeter	space inside a tiny block with 1-cm sides [9]

Materials

- 1-cm cubes, two different small boxes per group, trays
- Slides 1-8, 10-11
- Video clip 1 (0:00-3:02) on slide 6 and Video clip 3 (0:00-5:00) on slide 8
- Worksheet Task A and Worksheet Task B copies
- Recording sheet with ___ cubic units, pencils, mini whiteboards

Before the lesson

- Print Worksheet Task A and Task B, one per student
- Test Video clip 1 on slide 6 and Video clip 3 on slide 8 for sound and picture
- Set out trays with 1-cm cubes and two different small boxes per group
- Pre-fill the bottom layer of one box per group for support

Lesson outline

0–8 min **Starter** 8 min · Whole class

Spark curiosity about which container holds more and link to volume.

YOU DO

1. Show two boxes that look almost the same size and hold them up side by side.
2. Say the hook and take a quick vote using Slide 2.
3. Ask how students could prove which holds more without guessing.
4. Show Slide 1 title and link answers to measuring space inside.

STUDENTS DO

1. Look at the two boxes and vote: tall thin box, short wide flat box, or cube-shaped box.
2. Tell a partner one fair way to prove which holds more.
3. Share ideas with the class.

Say: I have two boxes that look almost the same size. Which one can actually hold more, and how could we prove it? Vote, then tell a neighbor how you would prove it without just guessing.

Ask: Which box do you think holds more, and why? (Answers vary, but listen for reference to space inside, not how tall it looks.) · How is filling a box different from wrapping it? (Filling is about space inside; wrapping is about covering the outside.)

Check understanding: Show of hands for each vote choice plus one reason. If students focus only on height, hold a tall thin box next to a short wide box and ask which fits more cubes.

Support: Let students pick up both boxes and look inside before voting. **Stretch:** Ask students to predict what box shape would hold about twice as many cubes.

Use: Slides 1-2

Created with LessonDino.com · AI lesson planner with checkable sources

8–20 min **Teaching** 12 min · Whole class

Teach that volume is an attribute of solids measured in cubic units.

YOU DO

1. Show Slide 4 big idea and explain volume with the 1-cm cube in hand.
2. Play Video clip 1 (0:00-3:02) on Slide 6 and pause to stress flat shapes have none.
3. Model Slide 7 steps: pick one unit cube, fill with no gaps or overlaps, count cubes.
4. Show Slide 3 fact about the 10-cm cube as a benchmark.

STUDENTS DO

1. Watch the video for what counts as volume and why flat shapes have none.
2. Measure the 1-cm cube sides and repeat: My cube = 1 cubic centimeter = 1 cm3.
3. Choral repeat the three steps for measuring volume.

Say: Volume is how much space a solid takes up. Volume is the measure of 3-dimensional space occupied by matter, or enclosed by a surface, measured in cubic units [4]. We fill with no gaps or overlaps [3], then count how many unit cubes fit.

Worked example: Teacher packs a small tray: bottom layer is 4 cubes long and 2 cubes wide, so 8 cubes. Add a second full layer of 8. Total 8 + 8 = 16 cubes, so volume is 16 cubic units. A cube with sides each measuring 1 cm has a volume of 1 cm3 [9].

Ask: What is volume? (How much space a solid takes up inside.) · Why do we say cubic centimeters, not just centimeters? (Because volume is measured in cubic units [6], we count whole blocks, not lines.) · Can a flat square have volume? (No, it has no height to hold cubes; only solid figures have volume.)

Check understanding: Mini whiteboards: students write volume in own words and draw a 1-cm cube labeled 1 cm3. Reteach with another cube demo if many draw a square.

Support: Give sentence frame: Volume tells ____. One cubic centimeter is ____. **Stretch:** Ask partners to discuss how big a cubic meter would be and what could fit inside it.

Use: Slides 3-7, Video clip 1 (0:00-3:02)

20–45 min **Main activity** 25 min · Groups

Build understanding by packing boxes and counting cubes to compare volume.

YOU DO

1. Demo packing Box A with 1-cm cubes in neat rows, columns, and layers.
2. Hand out trays, cubes, and two boxes and start groups on Cube Fill-Up.
3. Circulate, ask about rows, columns, and layers, and check counts.
4. Move groups that finish to Worksheet Task B counting practice.

STUDENTS DO

1. Work in small groups to pack each box with 1-cm cubes in rows and layers.
2. Count cubes layer by layer and record each result as ___ cubic units.
3. Compare boxes and explain which has greater volume and how they know.

Say: Pack each box with 1-cm cubes in neat rows, columns, and layers. Make no gaps and no overlaps. Count the cubes to find how much space each box takes up, record as ___ cubic units, and tell which box has greater volume.

Worked example: Group demo: Box A bottom layer is 5 by 3 = 15 cubes. There are 2 layers. 15 + 15 = 30, so Box A = 30 cubic units. Box B bottom layer is 4 by 3 = 12 cubes with 2 layers = 24 cubic units. Box A has greater volume because 30 is more than 24.

Ask: How many cubes in one layer, and how many layers did you make? (For example, 15 cubes per layer times 2 layers = 30 cubic units.) · Which box has greater volume? How do you know? (The box with more cubes counted has greater volume because volume is space inside.)

Check understanding: Check recording sheets for correct counts and units. If counts differ, have group recount one layer aloud and check for gaps or hidden spaces.

Support: Start with one box that already has the bottom layer filled so students can see the row and column structure before counting up. **Stretch:** Have students predict a third box that would hold about twice as many cubes, then test it by filling.

Use: Slides 7-8, Video clip 3 (0:00-5:00), Worksheet Task B

Created with LessonDino.com · AI lesson planner with checkable sources

45–60 min **Plenary** 15 min · Whole class

Check that students can recognize volume and name correct units.

YOU DO

1. Lead Think, pair, share with Slide 5: How is filling a box different from wrapping it?
2. Review Slide 10 key words and Slide 11 quick quiz as whole class.
3. Hand out Worksheet Task A true or false for independent check.
4. Close by restating volume and previewing measuring larger solids.

STUDENTS DO

1. Discuss with a partner, then share filling versus wrapping ideas.
2. Answer quiz questions on whiteboards using cubic units.
3. Complete Worksheet Task A true or false on their own.

Say: Volume is the amount of space occupied by a solid [9]. Some learners compute surface area instead of volume when asked to find volume [3]. Filling is volume in cubic units; covering or wrapping is not volume.

Worked example: Quiz fix-it: A student added the faces to get 40 square units for a toy chest. That measured the outside. The chest packed with 20 unit cubes, so volume is 20 cubic units. Milliliters are also cubic units because milliliter is a special name for the cubic centimeter [4].

Ask: Filling a toy chest needs volume, area, or perimeter? (Volume, because it is about space inside the solid.) · What unit do we use for volume? (Cubic units, like cubic centimeters.)

Check understanding: Collect Task A and scan quiz boards; if many miss units, re-show the 1-cm cube and practice saying 1 cubic centimeter = 1 cm3.

Support: Post helper chart: area = square units for covering, volume = cubic units for filling. **Stretch:** Let pairs create one tempting wrong answer that mixes outside and inside for another pair to fix.

Use: Slides 5, 10-11, Worksheet Task A

Common mistakes

Mistake	How to spot it	How to fix it
Finding surface area when asked for volume	Student adds faces or talks about wrapping and answers in square units	Ask: Are we covering the outside or measuring space inside [6]? Repack with cubes to show volume is inside [3].
Leaving gaps or overlaps when packing and miscounting	Layers are messy or total does not match layer-by-layer count	Rebuild as rows, columns, and layers with no gaps or overlaps [3] and count one layer at a time.
Using cm instead of cubic units, or thinking flat shapes have volume	Writes 12 cm for a box or says a square has volume	Hold up the 1-cm cube: a cube with 1-cm sides is 1 cm3 [9]; flat shapes cannot hold cubes so have no volume.

Support

- Pre-fill the bottom layer so the row and column structure is visible before counting up.
- Use picture cards with around, cover, fill, hold, and space inside underlined.

Stretch

- Predict a third box that would hold about twice as many cubes, then test by filling.
- Find two different objects thought to have almost the same volume and explain reasoning.

For the LSE or teaching assistant

Stay with the Cube Fill-Up groups. Help line up rows and layers, count aloud layer by layer, and prompt recording in ___ cubic units.

Check for understanding

Question	Answer
What is volume?	How much space a solid takes up inside.
You pack a box with 18 unit cubes with no gaps. What is its volume?	18 cubic units.
Which needs volume: putting a fence around a yard, painting a wall, or filling a storage bin?	Filling a storage bin.

Homework

Find one small container at home and write two sentences about what its volume means.

Sources

1. Grade 5 Math Curriculum - Fairfax County Public Schools · fcps.edu · https://www.fcps.edu/academics/elementary/fifth-grade/year-at-a-glance/math
2. Mathematics Grade 5 - Chicago Public Schools · cps.edu · https://www.cps.edu/sites/skyline/curriculum/mathematics/grade-5/
3. Winter Edition 2013 Calculus Students' Understanding of Volume · files.eric.ed.gov · https://files.eric.ed.gov/fulltext/EJ1052960.pdf
4. SI Units - Volume | NIST · nist.gov · https://www.nist.gov/pml/owm/si-units-volume
5. Calculus Students' Understanding of Area and Volume Units · files.eric.ed.gov · https://files.eric.ed.gov/fulltext/EJ1082070.pdf
6. Circumference, Area and Volume | NIST · nist.gov · https://www.nist.gov/pml/owm/circumference-area-and-volume
7. Understanding Volume Estimation Uncertainty of Lakes and ... · ntrs.nasa.gov · https://ntrs.nasa.gov/api/citations/20230014037/downloads/Understanding%20Volume_manuscript.pdf
8. Deepening Student Understanding of Area and Volume by ... · journals.calstate.edu · https://journals.calstate.edu/jcmp/article/download/5289/4301/16173
9. What is volume? - KS2 Maths - Year 6 - BBC Bitesize · bbc.co.uk · https://www.bbc.co.uk/bitesize/articles/zcrxtyc
10. Calculating volume - KS2 Maths - Year 6 - BBC Bitesize · bbc.co.uk · https://www.bbc.co.uk/bitesize/articles/z3jrxfr
11. Volume Facts for Kids · kids.kiddle.co · https://kids.kiddle.co/Volume

Created with LessonDino.com · AI lesson planner with checkable sources