

Solid Figures and Volume

Unit 11 Overview: 10 lessons

Students name solid figures by their faces, edges and vertices and match nets to the solids they fold into. Then they find volume: they fill boxes with unit cubes, count cubic centimeters, inches and feet, multiply the bottom layer by the number of layers, and use $V = l \times w \times h$ and $V = B \times h$. They find a missing edge, build different boxes with the same volume, add the volumes of two prisms joined together, solve volume stories, and decide whether a job needs perimeter, area or volume. Volume comes after the multiplying of Unit 3 and the conversions of Unit 10, and stands on the area of 4th grade: a base is an area, and the layers stack on it. Some states add solid figures and nets, missing edges, and choosing the measure.

THE UNIT, DAY BY DAY

Day 1	Pre-Check	What students already know, before the first lesson.
Day 2	11.1 Solid figures ★	I can name solids by their faces, edges and vertices.
Day 3	11.2 Nets of solids ★	I can match a net to the solid it folds into.
Day 4	11.3 Unit cubes and cubic units	I can find volume by counting unit cubes.
Day 5	11.4 Count cubes to find volume	I can find volume in cubic units, centimeters and inches.
Day 6	11.5 Bottom layer times layers	I can multiply the bottom layer by the layers.
Day 7	11.6 The volume formulas	I can use the formulas to find volume.
Day 8	11.7 Missing edges and same volume ★	I can find a missing edge from the volume.
Day 9	11.8 Two prisms together	I can add the volumes of two prisms.
Day 10	11.9 Volume stories	I can solve volume story problems.
Day 11	11.10 Perimeter, area or volume ★	I can choose perimeter, area or volume.
Day 12	Unit Review	The review, to go over together.
Day 13	Unit Test	Form A; Form B (other numbers) is for a retest.

★ Taught in 5th grade in some states. Skip these lessons if yours teaches them in another grade; animalmath.com/standards shows your state's list.

GET READY FOR THE UNIT

- Centimeter cubes or snap cubes, about 40 for each pair, and a few inch cubes
- Small boxes to fill, and boxes from home to measure
- Solids to hold, or straws and clay balls to build them
- Grid paper and isometric dot paper (the Graph Paper maker prints both), scissors and tape
- A wall chart: $V = l \times w \times h$ and $V = B \times h$, in cubic units

HOW EACH LESSON GOES

- 1. Warm up** (5 min)
- 2. Teach** (10 min)
- 3. Try it together** (10 min)
- 4. Practice** (15 min)
- 5. Exit ticket** (5 min): a quick check on the lesson.

Each lesson page ends with the Animal Math sheets, makers, tools and quizzes for it. "Sheet 3" is the third worksheet of a pack; a color pack prints each sheet again in black and white.

CHECKING AS YOU GO

PRINTABLE	Pre-Check: Day 1, with a key	EXIT TICKET	Exit Tickets: one a lesson, two to a page
PRINTABLE	Unit Review: the day before the test	PRINTABLE	Unit Test: Forms A and B, with keys



Solid Figures and Volume

Lesson 11.1: Solid figures

GOAL Students name prisms, pyramids, cylinders, cones and spheres by their faces, edges and vertices. A prism has two matching bases joined by rectangles; a pyramid has one base and triangles that meet at one vertex, the apex. **About 45 minutes** ★ Taught in 5th grade in some states

I can name solids by their faces, edges and vertices.

THE LESSON

- 1 Warm up** (5 min) Hold up a box, a can and a party hat. Students sort them: which have only flat faces, and which have a curved surface?
- 2 Teach** (10 min) Build a box with straws and clay: 6 faces, 12 straw edges and 8 clay vertices. Its two bases match, so it is a prism, a rectangular prism, with no apex. Build a square pyramid: a square base and 4 triangles, 5 faces, 8 edges and 5 vertices; the triangles meet at the apex. Then the curved solids: a cylinder has 2 flat circles, a cone 1 flat circle and an apex, a sphere no flat face.
Say: "A prism has two matching bases; a pyramid has one base and an apex. I name a solid for its base, and I mark each edge as I count it."
- 3 Try it together** (10 min) Pairs build a triangular prism, fill in its row of the table and check: the faces and vertices together are 2 more than the edges. Then they sort the room's solids into prisms, pyramids and curved solids.
- 4 Practice** (15 min) Students name solids and everyday objects on sheet 1 of Solid Figures: Faces, Edges and Vertices, count faces, edges and vertices and sort the solids on sheet 2, and compare flat shapes with solids on sheet 3. Early finishers draw a prism and a pyramid on the same base and list how they differ.
- 5 Exit ticket** (5 min) Students do **Exit Ticket 11.1** and circle a face beside the "I can" line. On question 1, look for 7 faces, 15 edges and 10 vertices; 5 faces leaves out the bases, and 10 edges misses the 5 that join them. On question 2, look for the two pyramids circled; a circled cube or prism means any corner was taken for an apex.

Ready for more? A prism and a pyramid each have an octagon for a base. Without a picture, find the faces, edges and vertices of each.

GET READY

- Solids to hold: boxes, a can, a party hat, a ball
- Straws and clay balls
- A table: solid, faces, edges, vertices

WORDS TO USE

face: a flat surface of a solid

edge: where two faces meet

vertex: a corner where edges meet

apex: the vertex across from the base

ASK

- How many bases does it have? What shape are they?
- Does it have an apex? How do you know?
- How many faces meet at this vertex?

WATCH FOR

Counts only what can be seen. Turn the solid, or count the dashed edges too.

Calls any corner an apex. An apex is the one vertex across from the base. A prism has none.

Counts a curved surface as a face. A face is flat: a cylinder has 2.

Need help? Put a dot of clay on each vertex of a real solid as it is counted. The Shapes Quiz's Solid Shapes level reviews the names of the solids.

ON ANIMAL MATH

PRINTABLE

Solid Figures: Faces, Edges and Vertices: sheets 1-3

QUIZ

Shapes Quiz: the Solid Shapes level

EXIT TICKET

5th Grade Solid Figures and Volume Exit Tickets: Exit Ticket 11.1

Solid Figures and Volume

Lesson 11.2: Nets of solids

GOAL Students match a net, a flat pattern of faces, to the solid it folds into: the number and shapes of its faces name the solid. They test patterns of six squares to see which fold into a cube, and draw a net for a box on grid paper.

About 45 minutes

★ Taught in 5th grade in some states

I can match a net to the solid it folds into.

THE LESSON

- 1 Warm up** (5 min) Cut a small box open along some of its edges and lay it flat. Ask: how many faces? What shapes? Can it fold back up?
- 2 Teach** (10 min) Show a net of 2 triangles and 3 rectangles: two matching bases and rectangles round them fold into a triangular prism. Show a net of a square with a triangle on each side: one base and triangles that meet at an apex fold into a square pyramid. Then six squares. A T, a column of 4 squares with one square on each side of the top one, folds into a cube. A 2 by 3 rectangle of squares does not: squares land on top of each other and two faces are left open.
Say: "I count the faces and look at their shapes. Two matching bases and rectangles fold into a prism; one base and triangles fold into a pyramid. For a cube, I fold it in my head, square by square."
- 3 Try it together** (10 min) Pairs cut out five patterns of six squares from grid paper: the cross, the T, a 2 by 3 rectangle, a row of 5 with one square under its end, and one of their own. They predict yes or no, then fold to check. Then they draw a net for a box 4 cm by 3 cm by 2 cm and fold it.
- 4 Practice** (15 min) Students match nets to solids, test six patterns for a cube and draw a box's net on sheet 4 of Solid Figures: Faces, Edges and Vertices. Graph Paper gives more room for nets. Early finishers find two more patterns of six squares that fold into a cube.
- 5 Exit ticket** (5 min) Students do **Exit Ticket 11.2** and circle a face beside the "I can" line. On question 1, look for pentagonal pyramid; pentagonal prism mixes up prism and pyramid, and triangular pyramid names it for its triangles. On question 2, look for yes, then no; a yes on the second means it was not folded: the two squares under the row of four both fold onto the bottom.

Ready for more? Draw every pattern of six squares that folds into a cube. There are eleven in all, not counting turns and flips.

GET READY

- A small box to cut open
- Nets drawn on 1 centimeter grid paper (the Graph Paper maker prints it)
- Scissors and tape

WORDS TO USE

net: a flat pattern that folds into a solid

fold: bend along an edge so two faces meet

base: the face a solid is named for

ASK

- How many faces will the solid have? What shapes?
- Which square will be the bottom? The top?
- Do any two squares land on the same face?

WATCH FOR

Names a pyramid by its triangles. A solid is named for its base: count the sides of the one face that is not a triangle.

Thinks any six squares fold into a cube. Cut it out and fold it. Two squares on one face means no.

Draws a box net with faces that do not match. Opposite faces match: label top, bottom, front, back and the two sides before folding.

Need help? Cut each net out and fold it, then name the solid while holding it.

ON ANIMAL MATH

PRINTABLE

Solid Figures: Faces, Edges and Vertices: sheet 4

MAKER

Graph Paper: Paper Type Square Grid, Square Size 1 Centimeter

EXIT TICKET

5th Grade Solid Figures and Volume Exit Tickets: Exit Ticket 11.2

Solid Figures and Volume

Lesson 11.3: Unit cubes and cubic units

GOAL Students see volume as the space a solid takes up, counted in unit cubes: a cube 1 unit long on each edge is 1 cubic unit. They build figures from unit cubes, count every cube, hidden ones too, and compare figures by their volume.

About 45 minutes

I can find volume by counting unit cubes.

THE LESSON

- 1 Warm up** (5 min) Hold up a square tile and a cube. Ask: which one covers a space, and which one fills a space? Area counts squares; volume counts cubes.
- 2 Teach** (10 min) Build a wall of cubes 4 long and 2 tall: 8 cubes, so 8 cubic units. Then build a row of 4 cubes with 3 more stacked on its end cube: $4 + 3 = 7$ cubic units, and the cube under the stack counts too. Turn the figure around: the volume does not change. Last, fill a small box with cubes, no gaps and no overlaps: the cubes that fill it are its volume.
Say: "Volume is how many unit cubes fill a solid, with no gaps and no overlaps. Each cube is 1 cubic unit, and the cubes I cannot see count too."
- 3 Try it together** (10 min) Pairs each build a figure of 10 to 15 cubes, trade, and count each other's figure layer by layer. Then each pair builds two figures that look different but have the same volume, and shows the class.
- 4 Practice** (15 min) Students start with sheet 1 of Counting Cubes, a 3rd grade warm up, then find the volume in cubic units of problems 1 to 4 on sheet 1 of Volume of Rectangular Prisms. Early finishers build the Counting Cubes figures with real cubes to check their counts.
- 5 Exit ticket** (5 min) Students do **Exit Ticket 11.3** and circle a face beside the "I can" line. On question 1, look for 11 cubic units; a smaller number means the cubes under the top ones were not counted. On question 2, look for the figure of 10 cubes circled; circling the spread out one means its size on the page was judged, not its cubes.

Ready for more? Build three different figures with a volume of 9 cubic units. Which one fits in the smallest box?

GET READY

- Unit cubes, about 30 for each pair
- A square tile and a cube to compare
- A small box to fill with cubes

WORDS TO USE

volume: the space a solid takes up

unit cube: a cube 1 unit long on each edge

cubic unit: the space of one unit cube: the unit for volume

ASK

- How many cubes are in the bottom layer? The next one?
- Are there cubes you cannot see? How do you know?
- Does turning the figure change its volume?

WATCH FOR

Counts only the cubes that show. Build it, then take it apart layer by layer.

Writes square units. Squares cover and cubes fill: volume is in cubic units.

Thinks the figure that looks bigger has more volume. Count both: a flat row of 9 cubes looks long, but a block 2 by 2 by 3 holds more.

Need help? Build each figure with real cubes, then count them as they come off.

ON ANIMAL MATH

PRINTABLE **Volume of Rectangular Prisms:** sheet 1, problems 1-4

PRINTABLE **Counting Cubes:** sheet 1, a 3rd grade warm up

QUIZ **Volume Quiz:** the Count Cubes level

EXIT TICKET **5th Grade Solid Figures and Volume Exit Tickets:** Exit Ticket 11.3

Solid Figures and Volume

Lesson 11.4: Count cubes to find volume

GOAL Students find volume by counting unit cubes of a given size, cubic centimeters, cubic inches and cubic feet, and write the volume with its unit. They see that the unit tells the size of each cube, so the same number of bigger cubes is more space.

About 45 minutes

I can find volume in cubic units, centimeters and inches.

THE LESSON

- 1 Warm up** (5 min) Pass around a centimeter cube, an inch cube and the cubic foot. Students guess how many centimeter cubes would fill the cubic foot.
- 2 Teach** (10 min) Build a box 4 by 3 by 2 from centimeter cubes: 12 in a layer, 2 layers, 24 cubic centimeters (24 cubic cm). Build a box 4 by 3 by 2 from inch cubes: 24 cubes again, but 24 cubic inches is far bigger. The number counts the cubes; the unit tells their size. A box that 6 cubic feet fill has a volume of 6 cubic feet.
Say: "I count the cubes and name their size. A number without its unit is not a volume."
- 3 Try it together** (10 min) Pairs build a box from centimeter cubes and the same box from inch cubes, then write each volume with its unit and say which is bigger. Then each draws a figure of 5 to 10 cubes on isometric dot paper and trades it to be counted.
- 4 Practice** (15 min) Students write each volume with its unit on problems 5 to 8 of sheet 1 of Volume of Rectangular Prisms, then count layer by layer on sheet 5 of Solid Figures: Faces, Edges and Vertices. Early finishers draw a box of 18 cubic centimeters on dot paper.
- 5 Exit ticket** (5 min) Students do **Exit Ticket 11.4** and circle a face beside the "I can" line. On question 1, look for 36 cubic cm; 12 means one layer was counted, and 18 only the front face. On question 2, look for 12 cubic inches; 12 with no unit, or square inches, means the unit was not read.

Ready for more? A cubic foot is 12 inches on each edge. How many cubic inches is it?

GET READY

- Centimeter cubes and inch cubes
- A cubic foot: a box 1 foot on each edge
- Isometric dot paper (the Graph Paper maker prints it)

WORDS TO USE

cubic centimeter: a cube 1 cm on each edge

cubic inch: a cube 1 inch on each edge

cubic foot: a cube 1 foot on each edge

ASK

- What size is each cube?
- How many cubes are in one layer? How many layers?
- What unit goes with your number?

WATCH FOR

Leaves off the unit, or writes square units.

Name the cube's size every time.

Counts only the front face. Count the cubes in one layer, then the layers.

Thinks more cubes always means more space.

Compare 24 cubic centimeters with 24 cubic inches.

Need help? Build the box with real cubes of that size and count one layer before stacking.

ON ANIMAL MATH

PRINTABLE

Volume of Rectangular Prisms: sheet 1, problems 5-8

PRINTABLE

Solid Figures: Faces, Edges and Vertices: sheet 5

MAKER

Graph Paper: Paper Type Isometric Dots, Square Size 1 Centimeter

QUIZ

Volume Quiz: the Count Cubes level

EXIT TICKET

5th Grade Solid Figures and Volume Exit Tickets: Exit Ticket 11.4

Solid Figures and Volume

Lesson 11.5: Bottom layer times layers

GOAL Students find how many unit cubes fill a box without counting them all: the cubes in the bottom layer (rows times cubes in a row) times the number of layers. They see the box fill layer by layer and write it as one multiplication.

About 45 minutes

I can multiply the bottom layer by the layers.

THE LESSON

- 1 Warm up** (5 min) Draw an array of 6 rows of 4 squares. Students find how many squares there are without counting one by one.
- 2 Teach** (10 min) Draw a box with a row of 7 cubes along its front, 4 cubes along its side and a stack of 5 in the corner. The bottom layer is 4 rows of 7, 28 cubes. The stack shows 5 layers of 28: $28 + 28 + 28 + 28 + 28$, or $28 \times 5 = 140$ cubes. Then a box with a bottom layer of 8 by 4, 32 cubes, and 2 layers: $32 \times 2 = 64$ cubes.
Say: "I find the cubes in the bottom layer, rows times cubes in a row. Then I multiply by the number of layers."
- 3 Try it together** (10 min) Pairs fill a small box with centimeter cubes one layer at a time, writing the total after each layer, and check it with bottom layer times layers. Then they find the volume of a box with a bottom layer of 9 by 2 and 6 layers.
- 4 Practice** (15 min) Students find the bottom layer, the layers and the volume of each clear box on sheet 2 of Volume of Rectangular Prisms. Early finishers draw a clear box that holds 60 cubes, with a row along its front and a stack in its corner.
- 5 Exit ticket** (5 min) Students do **Exit Ticket 11.5** and circle a face beside the "I can" line. On question 1, look for $18 \times 3 = 54$; 10 means only the cubes drawn were counted. On question 2, look for 84 cubic units; 21 means the layers were left out, and 25 means 21 and 4 were added.

Need help? Fill the box with real cubes, one layer at a time, and say the total after each layer.

Ready for more? A box holds 96 cubes in 4 layers. What could its bottom layer be? Find two answers.

GET READY

- Small boxes and centimeter cubes
- A clear container, if you have one
- Drawings of boxes with one row of cubes and one stack drawn in

WORDS TO USE

bottom layer: the cubes that cover the floor of the box

layer: one flat level of cubes

row: cubes in a line along one edge

ASK

- How many cubes fit along the front? Along the side?
- How many cubes are in the bottom layer?
- How many layers fill the box?

WATCH FOR

Counts only the cubes drawn. The drawn cubes show the rows; picture the whole floor filled.

Adds the layer and the layers. Each layer is a full floor of cubes: multiply.

Takes the stack for the bottom layer. The stack tells how many layers; the front row and the side row make the bottom layer.

ON ANIMAL MATH

PRINTABLE

Volume of Rectangular Prisms: sheet 2

QUIZ

Volume Quiz: the Layers level

EXIT TICKET

5th Grade Solid Figures and Volume Exit Tickets: Exit Ticket 11.5

Solid Figures and Volume

Lesson 11.6: The volume formulas

GOAL Students find the volume of a rectangular prism with $V = l \times w \times h$, and with $V = B \times h$, where B is the area of the base. They see that both say the same thing as the bottom layer times the layers, and write the volume in cubic units.

About 45 minutes

I can use the formulas to find volume.

THE LESSON

- 1 Warm up** (5 min) Multiply three numbers two ways on whiteboards: $(6 \times 5) \times 2$ and $6 \times (5 \times 2)$. Does the grouping change the product? Which way is easier?
- 2 Teach** (10 min) Draw a box 9 cm long, 4 cm wide and 6 cm tall. The bottom layer is $9 \times 4 = 36$ cubes and there are 6 layers:
 $V = l \times w \times h = 36 \times 6 = 216$ cubic cm. Now $V = B \times h$: a box with a base of 35 square inches and a height of 8 inches has $V = 35 \times 8 = 280$ cubic inches. B is $l \times w$ already, so it is multiplied only by the height.
Say: "Length times width is the base, the bottom layer. Times the height is all the layers. $V = l \times w \times h$ and $V = B \times h$ say the same thing."
- 3 Try it together** (10 min) Pairs measure two boxes from the room to the nearest centimeter, find each volume with $l \times w \times h$ and check with $B \times h$. Then the class finds the volume of a box 25 ft by 7 ft by 4 ft, multiplying in the easiest order.
- 4 Practice** (15 min) Students use $V = l \times w \times h$ on problems 1 and 2 and $V = B \times h$ on problems 3 to 5 of sheet 3 of Volume of Rectangular Prisms; the missing edges at the bottom wait for lesson 11.7. Early finishers find the volume of a cube with edges of 9 cm.
- 5 Exit ticket** (5 min) Students do **Exit Ticket 11.6** and circle a face beside the "I can" line. On question 1, look for 720 cubic cm; 29 means the edges were added. On question 2, look for 378 cubic in.; 51 means B and h were added, and 368 means the 1 regrouped from 9×2 was dropped.

Ready for more? Two boxes: one 15 by 4 by 2, one 10 by 3 by 4. Which holds more? Explain without building them.

GET READY

- Boxes with whole number edges in centimeters or inches
- Rulers
- The formula chart

WORDS TO USE

l, w and h: the length, width and height: the three edges of a box

base (B): the area of the bottom face, in square units

formula: a rule with letters: $V = l \times w \times h$

ASK

- Which two edges make the base?
- Which order makes the multiplying easiest?
- Why is the answer in cubic units?

WATCH FOR

Adds the three edges. Build one layer: rows times cubes in a row, then times the layers.

Multiplies B by the length or width too. B is the base already, length times width: multiply it only by the height.

Writes square units. A base is in square units; a volume is in cubic units.

Need help? Shade the base on a drawing and write its area first, then multiply by the height.

ON ANIMAL MATH

PRINTABLE

Volume of Rectangular Prisms: sheet 3, problems 1-5

QUIZ

Volume Quiz: the Use a Formula level

EXIT TICKET

5th Grade Solid Figures and Volume Exit Tickets: Exit Ticket 11.6

Solid Figures and Volume

Lesson 11.7: Missing edges and same volume

GOAL Students find a missing edge from a box's volume: multiply the two edges they know, then divide the volume by that product. They build different boxes with the same volume: the edges change, the volume does not.

I can find a missing edge from the volume.

About 45 minutes

★ Taught in 5th grade in some states

THE LESSON

- 1 Warm up** (5 min) Missing factors on whiteboards: $8 \times ? = 56$, $6 \times ? = 72$ and $12 \times ? = 96$.
- 2 Teach** (10 min) A box has a volume of 210 cubic cm, and its base is 7 cm by 5 cm. How tall is it? Multiply the edges you know: $7 \times 5 = 35$ square cm. Then $35 \times ? = 210$, so $210 \div 35 = 6$ cm. Check: $7 \times 5 \times 6 = 210$. Then build boxes from 30 cubes: 5 by 3 by 2, 6 by 5 by 1 and 10 by 3 by 1, other edges but the same 30 cubic units.
Say: "To find a missing edge, I multiply the two edges I know, then divide the volume by that. Boxes with the same volume have edges with the same product."
- 3 Try it together** (10 min) Pairs build every box they can from 30 cubes and record the edges in a table. Then they solve two cards: a volume of 144 cubic inches with a base 6 in. by 4 in., and a volume of 270 cubic ft with a base 9 ft by 3 ft.
- 4 Practice** (15 min) Students find the missing edges in problems 6 and 7 of sheet 3, then circle every box with a volume of 24 cubic units at the bottom of sheet 5 of Volume of Rectangular Prisms. Early finishers list every box with whole number edges and a volume of 40 cubic units.
- 5 Exit ticket** (5 min) Students do **Exit Ticket 11.7** and circle a face beside the "I can" line. On question 1, look for 8 ft; 40 means 360 was divided by 9 only, and 346 means the edges were subtracted. On question 2, look for two boxes whose edges multiply to 48, such as $2 \times 3 \times 8$ and $3 \times 4 \times 4$; the same three edges in another order are the same box.

Ready for more? A box is 16 cm by 5 cm by 3 cm. Find another box with the same volume and no edge the same.

GET READY

- Centimeter cubes, 30 for each pair
- Missing edge cards
- Whiteboards and markers

WORDS TO USE

missing edge: the edge to find

product: the answer to a multiplication

same volume: the same number of cubic units, in a box of another shape

ASK

- Which two edges do you know? What is their product?
- What number times the base gives the volume?
- Is 4 by 3 by 2 a different box from 2 by 3 by 4?

WATCH FOR

Divides the volume by one edge only. Multiply the two known edges first: that is the base.

Gives the same box twice, in another order. Build both: turning a box does not make a new one.

Subtracts to find the missing edge. Volume is a product, so undo it by dividing.

Need help? Build the base with cubes, then add layers until the cubes match the volume.

ON ANIMAL MATH

PRINTABLE

Volume of Rectangular Prisms: sheet 3, problems 6–7; sheet 5, the boxes of 24

QUIZ

Volume Quiz: the Use a Formula level

EXIT TICKET

5th Grade Solid Figures and Volume Exit Tickets: Exit Ticket 11.7



Solid Figures and Volume

Lesson 11.8: Two prisms together

GOAL Students find the volume of a solid made of two rectangular prisms: they split it into two boxes that do not overlap, find each box's edges (one may be found by subtracting), find each volume and add. Splitting another way gives the same volume.

About 45 minutes

I can add the volumes of two prisms.

THE LESSON

- 1 Warm up** (5 min) Build a step of cubes: a tower beside a low block. Ask: how could we find the cubes without counting them one by one?
- 2 Teach** (10 min) Draw a step-shaped solid: a tall part 3 cm long, 4 cm deep and 12 cm tall joined to a low part 8 cm long, 4 cm deep and 2 cm tall. Part A is $3 \times 4 \times 12 = 144$ and part B is $8 \times 4 \times 2 = 64$, so the solid is $144 + 64 = 208$ cubic cm. Split it across instead: a bottom slab 11 cm long and a top part 3 cm long, $12 - 2 = 10$ cm tall. Then $11 \times 4 \times 2 = 88$ and $3 \times 4 \times 10 = 120$, and $88 + 120 = 208$ again.
Say: "I split the solid into two boxes that do not overlap, find each volume and add. Any split gives the same total."
- 3 Try it together** (10 min) Pairs tape two small boxes into an L, measure each box and find the total volume. Then they build a block of cubes 5 by 2 by 3 with a 5 by 1 by 1 row beside it in another color, and find its volume by parts.
- 4 Practice** (15 min) Students count the cubes in each part of the two cube figures, then multiply and add for the solids on sheet 4 of Volume of Rectangular Prisms. Early finishers draw a step-shaped solid of their own, label its edges, and find its volume two ways.
- 5 Exit ticket** (5 min) Students do **Exit Ticket 11.8** and circle a face beside the "I can" line. On question 1, look for $90 + 42 = 132$ cubic m; 216 means the empty space above the low part was counted. On question 2, look for $8 + 6 = 14$ cubic units; a smaller number means hidden cubes were missed.

Need help? Build the solid with cubes in two colors, one color for each part, and count each part.

Ready for more? Find the volume of a box 10 by 7 by 4 with a box 3 by 3 by 4 cut out of one corner.

GET READY

- Centimeter cubes in two colors
- Two small boxes taped together into an L
- Drawings of step-shaped solids with their edges labeled

WORDS TO USE

composite solid: a solid made of two or more prisms

split: cut the solid into boxes that do not overlap

part: one of the boxes, with a volume of its own

ASK

- Where can you split the solid into two boxes?
- Which edges belong to each part?
- Does splitting another way change the volume?

WATCH FOR

Multiplies the outside edges as if it were one box. Shade the empty space above the low part: it is not part of the solid.

Uses the whole height for the low part. Label each part with its own edges before multiplying.

Counts the cubes where the parts meet twice. The parts touch but do not overlap: each cube is in one part.

ON ANIMAL MATH

PRINTABLE

Volume of Rectangular Prisms: sheet 4

QUIZ

Volume Quiz: the Two Prisms level

EXIT TICKET

5th Grade Solid Figures and Volume Exit Tickets: Exit Ticket 11.8

Solid Figures and Volume

Lesson 11.9: Volume stories

GOAL Students read a volume story, find the box's edges, sketch and label the box, write an equation with a letter for the unknown, and answer in cubic units. Some stories add the volumes of two boxes; some ask how much more one box holds.

About 45 minutes

I can solve volume story problems.

THE LESSON

- 1 Warm up (5 min)** Students guess how many cubic inches a lunch box holds, then measure its edges and multiply to check.
- 2 Teach (10 min)** Read: A cooler is 16 inches long, 11 inches wide and 10 inches tall. How much space is inside it? Sketch the box, label it, and write $V = 16 \times 11 \times 10 = 1,760$ cubic inches. Then two crates are stacked, one 12 in. by 10 in. by 5 in. and one 12 in. by 10 in. by 4 in.: in all, $600 + 480 = 1,080$ cubic inches. Last, two toolboxes, 20 in. by 5 in. by 7 in. and 15 in. by 7 in. by 7 in. How much more does the second hold? $735 - 700 = 35$ cubic inches.
Say: "I sketch the box, label its edges and write an equation. Then I ask: one box, boxes in all, or how much more?"
- 3 Try it together (10 min)** Pairs solve two story cards on whiteboards: a locker 12 in. by 15 in. by 30 in., and two cubbies, each 14 in. by 12 in. by 10 in. Each pair writes one equation on the board and the class checks it.
- 4 Practice (15 min)** Students solve the stories in problems 1 to 6 on sheet 5 of Volume of Rectangular Prisms, writing an equation for each. Early finishers write a story whose answer is 1,000 cubic centimeters.
- 5 Exit ticket (5 min)** Students do **Exit Ticket 11.9** and circle a face beside the "I can" line. On question 1, look for 1,920 cubic inches; 42 means the edges were added. On question 2, look for 12 cubic inches ($192 - 180$); 192 or 180 alone means only one box was found, and 372 means the volumes were added.

Need help? Sketch the box first and write each number from the story on its edge before multiplying.

Ready for more? A box holds 2,400 cubic inches, and its base is 20 inches by 12 inches. How tall is it? Write a story about it.

ON ANIMAL MATH

PRINTABLE

Volume of Rectangular Prisms: sheet 5, problems 1-6

QUIZ

Volume Quiz: the Word Problems level

EXIT TICKET

5th Grade Solid Figures and Volume Exit Tickets: Exit Ticket 11.9

GET READY

- Story cards about coolers, crates, lockers and toolboxes
- Grid paper for sketches
- Whiteboards and markers

WORDS TO USE

equation: a number sentence with a letter for the unknown: $V = 16 \times 11 \times 10$

in all: add the volumes of the boxes

how much more: subtract the smaller volume from the larger

ASK

- What are the box's length, width and height?
- Does the story ask about one box, two in all, or how much more?
- Is your answer about right? Round the edges to check.

WATCH FOR

Adds the three edges. Sketch the box and say it: the bottom layer times the layers.

Adds when the story asks how much more. Find both volumes, then subtract the smaller from the larger.

Writes inches for the answer. Space inside is a volume: cubic inches.

Solid Figures and Volume

Lesson 11.10: Perimeter, area or volume

GOAL Students read a story and decide what it measures: the distance around (perimeter, in units), the surface covered (area, in square units) or the space filled (volume, in cubic units). They solve it with the right formula and write the right unit.

About 45 minutes

★ Taught in 5th grade in some states

I can choose perimeter, area or volume.

THE LESSON

- 1 Warm up** (5 min) Hold up a tissue box. Ask what we would measure to run a string around its top, to cover its top with paper and to fill it with cubes.
- 2 Teach** (10 min) Read three questions about one raised flower bed, 8 ft long, 4 ft wide and 2 ft deep. Edging to go around it is a perimeter: $2 \times 8 + 2 \times 4 = 24$ feet. A cover for its top is an area: $8 \times 4 = 32$ square feet. Soil to fill it is a volume: $8 \times 4 \times 2 = 64$ cubic feet. The same box, three measures, three units.
Say: "I ask: does the story go around, cover or fill? Around is perimeter in units, cover is area in square units, fill is volume in cubic units."
- 3 Try it together** (10 min) Pairs sort eight story cards into perimeter, area and volume, then solve two: edging around a window 6 ft by 4 ft, and water to fill a tub 4 ft by 3 ft by 2 ft.
- 4 Practice** (15 min) Students circle perimeter, area or volume for each job in problems 7 to 12 on sheet 5 of Volume of Rectangular Prisms, then solve the area and perimeter stories on sheet 5 of Area and Perimeter Formulas, a 4th grade pack, for review. Early finishers write one story for each measure about the same box.
- 5 Exit ticket** (5 min) Students do **Exit Ticket 11.10** and circle a face beside the "I can" line. On question 1, look for perimeter circled and 28 feet; 45 means the area was found, and 14 means one length and one width were added. On question 2, look for volume circled and 9,600 cubic inches; 66 means the edges were added.

Ready for more? A box is 10 cm by 10 cm by 10 cm. Find the perimeter of its top, the area of its top and its volume. Why are the three numbers so different?

GET READY

- A box, paper and string to show around, cover and fill
- Story cards
- The formula chart

WORDS TO USE

perimeter: the distance around, in units

area: the surface covered, in square units

volume: the space filled, in cubic units

ASK

- Does the story go around, cover or fill?
- Which formula fits?
- What unit will your answer have?

WATCH FOR

Finds the area for every story. Act it out: walk around a desk, cover it with paper, fill a box with cubes.

Writes the wrong unit. Around is units, cover is square units, fill is cubic units.

Uses all three edges for an area. A cover is flat: two edges. Only a volume uses three.

Need help? Run a string around a real box's top, lay paper on it and fill it with cubes, saying perimeter, area and volume.

ON ANIMAL MATH

PRINTABLE

Volume of Rectangular Prisms: sheet 5, problems 7-12

PRINTABLE

Area and Perimeter Formulas: sheet 5, 4th grade review

QUIZ

Area and Perimeter Quiz: the Formulas level

EXIT TICKET

5th Grade Solid Figures and Volume Exit Tickets: Exit Ticket 11.10