Grade 7 Math · Lesson 8 — The New Storage Tank

Volume and Surface Area · ages 11 to 14 · 45 minutes · the workbook, one screen, this page, a pencil and paper

At a Glance

- **The book:** 7th Grade Math Workbook: Real-World Problem Solving, Chapter 8 (The Water Engineer), by Dr. Gene A Constant.
- **Free tool:** Measurement Master (reading a tape measure and ruler accurately), free, no login, plays in the browser: globalsovereignuniversity.org/measurement-master.
- **Free class:** Lesson 8 of the free Grade 7 Mathematics class: globalsovereignuniversity.org/grade-7-math-class#lesson-8.
- **Ages and time:** Grade 7 · ages 11 to 14 · 45 minutes.
- **Prep (5 min):** read the Teaching Creed and have the workbook open to Chapter 8. Find a small box and a handful of sugar cubes, dice or blocks.

Why this lesson

Volume tells how much a tank holds; surface area tells how much steel or paint it takes. Mixing the two up wastes real money, and filling a real box is the fastest way to keep them apart.

What the learner will be able to do

- Find the volume of rectangular and triangular prisms
- Find the volume of a cylinder
- Find the surface area of a prism
- Find the lateral and total surface area of a cylinder
- Use volume and surface area to compare designs and costs

The 45-Minute Climb

How to read this: the gold box in each step is your lesson, word for word. Run it as written. The notes beneath are optional support. "The group" means your family; "host" means you.

1 · The Hook (5 min)

"Fill a small box with sugar cubes or dice. Count how many fit along each edge. Can you find the total without counting every one?"

Say it like this: let your child do it with real objects if you can, then ask how they know their answer is right before you check it.

2 · Work It Together (15 min)

Open the workbook to the worked example An Underground Tank (Section 8.1) together: The tank is a rectangular prism 20 feet long, 15 feet wide and 10 feet deep. Multiply: 20 × 15 × 10. 20 × 15 = 300, and 300 × 10 = 3,000. The tank holds 3,000 cubic feet. Then read A Grain Silo (Section 8.2) together: A silo has a radius of 8 feet and a height of 25 feet. Use $V = \pi r^2 h$: 3.14 × 8² × 25. 8² = 64, and 64 × 25 = 1,600. 3.14 × 1,600 = 5,024. The silo holds 5,024 cubic feet.

Read each step aloud and let your child say the next step before you read it. Then play one round of Measurement Master.

3 · The Talk (8 min)

1. Why do you multiply, not add, to find volume? 2. When should a face be left out of surface area? 3. Two boxes hold the same amount. Why might one cost less to build?

You are not fishing for one right answer. You are listening for understanding:

- Q1: Each layer of cubes is length times width, and there are as many layers as the height.
- Q2: When it is not covered, such as the floor of a shed that is not painted.
- Q3: It can have less surface area, so it needs less wood or steel to make.

4 · Solo Climb (12 min)

Five problems on your own, with your work shown.
1. A raised bed is 12 feet long, 4 feet wide and 1.5 feet deep. Soil costs $4 a cubic foot. What does it cost to fill?
2. A fuel drum is 4 feet across and 6 feet tall. What is its volume?
3. A storeroom is 15 by 15 by 10 feet. A fan moves 250 cubic feet of air a minute. How long to change all the air once?
4. A tent has a triangular front and back (base 6 ft, height 4 ft) and two sloped sides 5 ft by 10 ft. No floor. How much canvas is needed?
5. A steam pipe is 2 feet across and 50 feet long. How much wrap covers its outside?

Why solo: a test, a job and real life ask you to work alone. Five problems rehearse exactly that. The answers are at the end of this plan.

Keep It Fresh (5 min, the next day)

Two review problems from the book's Extra Practice.
1. A circle has a diameter of 18 inches. Find its circumference and area.
2. A triangle has a base of 14 cm and an area of 63 square cm. What is its height?

Ready to move on? Four of the five Solo Climb problems right, with work shown, means this skill is solid. If not, reread the worked examples together and try two more problems from the chapter before the next lesson. Short review of old skills keeps them from fading.

5 · The Takeaway (5 min)

“Volume fills; surface area covers. Volume of a prism or cylinder is the base area times the height.” · Homework: Find a box at home. Measure it, work out its volume and its surface area, and decide how much wrapping paper it would take.

The badge moment: finishing all five steps earns the Bronze ring of this lesson’s badge, The Tank Builder. Mark it on the Climber’s Passport now; the homework is how Silver and Gold are earned during the week.

Common Mistakes to Watch For

- Adding the length, width and height instead of multiplying them.
- Counting a face that is not covered, such as a floor that is not painted.
- Leaving out the two round ends when a cylinder is closed.

The Teaching Creed

You are not the expert; the book and the method are. Your job is to ask “how do you know?” one more time than feels natural, and to celebrate wrong answers out loud. In here, a wrong answer is where the lesson lives.

GENO, GSU’s free tutor, can explain any step a second way, any hour, in 83 languages, with no login: globalsovereignuniversity.org/free-tutor. A prompt for the host: Ask GENO: “My child confuses volume and surface area. Help them see the difference with a cereal box, without giving the answer.”

Adapt It and Measure It

Differentiation

- Struggling: build each prism with blocks or sugar cubes before using the formula.
- Ahead: measure a real can and find how much it holds and how much label covers it.
- Large co-op: each team designs a tank and the group compares cost and size.
- Reluctant: let the child plan the wrapping paper for a real gift box.

Evidence of learning (no exam)

Look for three things. Tried: finished all five Solo Climb problems with work shown. Noticed: can name the mistake in Common Mistakes that they almost made. Changed: the next day, solves one new problem from the same chapter without help. Those three words are the whole rubric, and they match the badge tiers below.

Gamify It — The Campus Climb

Every GSU lesson is one badge on the Climber’s Passport, earned at four depths: Bronze, Silver, Gold and Platinum.

LESSON 8 BADGE — The Tank Builder · Bronze — The Climb: finished the 45-minute lesson, all five steps. · Silver — The Try: did the homework and explained it to the host. · Gold — The Proof: completed the chapter’s Action Report in the workbook with every answer checked against the Answer Key. · Platinum — The Teacher: ran this lesson as host for someone else. The harvest of a teacher is teachers.

Answers for the Host

1. $288 (72 cubic feet × 4)
2. 75.36 cubic feet (3.14 × 2² × 6)
3. 9 minutes (2,250 ÷ 250)
4. 124 square feet (24 + 100)
5. 314 square feet (2 × 3.14 × 1 × 50)

Keep It Fresh: 1. C = 56.52 inches; A = 254.34 square inches · 2. 9 cm

Every answer above comes from the workbook's own Answer Key. The book behind this lesson: 7th Grade Math Workbook: Real-World Problem Solving, Chapter 8 (The Water Engineer).

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